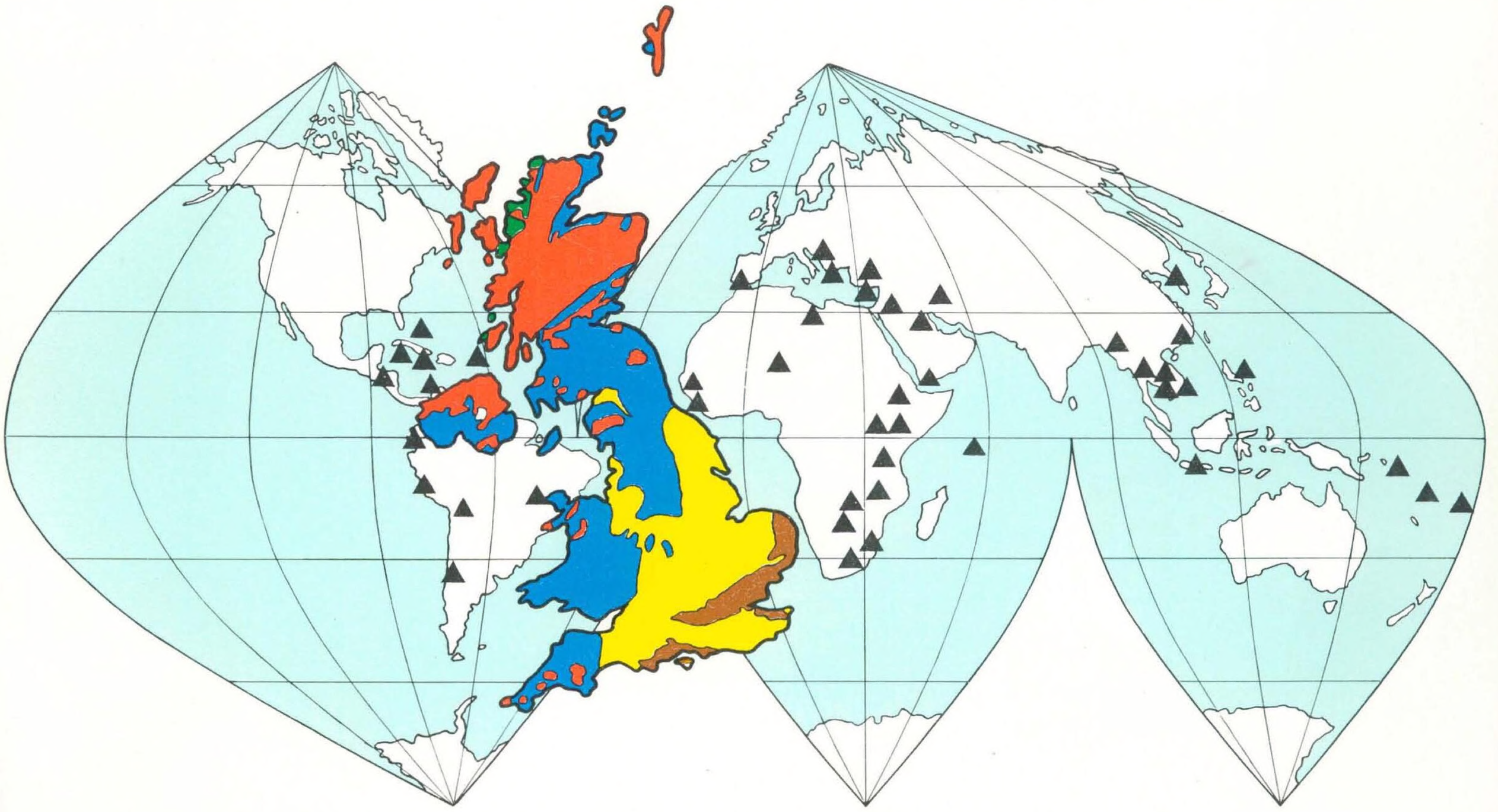
NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF GEOLOGICAL SCIENCES

The stratigraphy of the Cooden Borehole, near Bexhill, Sussex

REPORT No. 75/12



HMSO

The Institute of Geological Sciences is responsible both for the geological survey of Great Britain and for the programmes of British Technical Aid in geology in developing countries as arranged by the Ministry of Overseas Development and the United Nations and its agencies. This dual responsibility is illustrated by the map on the cover, the black triangles indicating the countries where technical aid has been promoted.

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF GEOLOGICAL SCIENCES

Report No. 75/12

The stratigraphy of the Cooden Borehole, near Bexhill, Sussex

R. D. Lake, MA

London: Her Majesty's Stationery Office 1975

The Institute of Geological Sciences was formed by the incorporation of the Geological Survey of Great Britain and the Museum of Practical Geology with Overseas Geological Surveys and is a constituent body of the Natural Environment Research Council.

It is recommended that reference to this report be made in the following form:

LAKE, R. D. 1975. The stratigraphy of the Cooden Borehole, near Bexhill, Sussex. *Rep. Inst. Geol. Sci.*, No. 75/12. 23 pp.

ISBN 0 11 880740 4

Contents

Illustrations

Summary

The Cooden Borehole was drilled by the Institute to prove the stratigraphy of the Bexhill area, Sussex. The Wealden (Lower Cretaceous) sequence, which commenced in basal Weald Clay and terminated in Ashdown Beds, is described in detail and its sedimentology is related to the regional depositional environment of the Wealden delta.

Sommaire

Le trou de sonde à Cooden était foré par l'Institute pour établir la stratigraphie de la région de Bexhill, Sussex. La succession du Weald (crétacé inférieur), qui commençait avec l'argile de la base du Weald et finissait avec les Ashdown Beds, est décrite en détail, et sa sedimentologie est liée à l'environnement régional des dépôts du delta du Weald.

Zusammenfassung

Das Institute bohrte das Cooden Bohrloch, um die Stratigraphie vom Bexhill, Sussex, zu bestätigen. Die Wealden (Unterkreide) Folge, die im Basal-Weald-Ton begann und in den Ashdown Beds zum Abschluss kam, wird ausführlich beschrieben, und die Sedimentologie wird zu der regionalen Ablagerungs umwelt vom Wealden-delta in Verbindung gebracht.

The stratigraphy of the Cooden Borehole, near Bexhill, Sussex

R. D. Lake, MA[1]

Introduction

The Cooden Borehole was drilled by the Institute of Geological Sciences in 1969 as part of the primary six-inch survey of the one-inch geological map, the Hastings (320) Sheet. This borehole was sunk to elucidate the detailed geology of the Bexhill area which had been shown on the Old Series Sheet as strata ranging from Lower Cretaceous Ashdown Beds to Tunbridge Wells Sand in age. Subsequent examination reveals that the strata can be assigned to the Tunbridge Wells Sand and, in the case of a small area at Cooden, to the Weald Clay.

REGIONAL GEOLOGY

From the evidence of detailed field surveys on the six-inch scale (by the author) of the country between Sidley and Cooden, it was not possible to confirm the age of the formation occupying the fault-bounded structure south-west of Sidley (see Fig. 1). Wadhurst Clay as shown on the Old Series Sheet was found to be absent. In the absence of distinctive fauna, sedimentological considerations showed that the sands, silts and clays of the area bore more resemblance to the Tunbridge Wells Sand of the Central Weald than to the Ashdown Beds exposed in the Hastings area. Structurally, however, either formation may be at the surface. In the absence of reliable information from boreholes penetrating the formation under consideration, it was decided to site a borehole on the assumed highest stratigraphic point of the area, at Cooden. A Weald Clay ostracod fauna had been identified at outcrop (Anderson, personal communication).

The Cooden borehole proved the sequence from basal Weald Clay down to Wadhurst Clay before penetrating a fault which brought in Ashdown Beds. Hence a cored sequence of Tunbridge Wells Sand was obtained to compare with that of the Central Weald at Cuckfield (Lake and Thurrell, 1974). Fig. 3 depicts the graphic section provided by the Cooden No. 1 borehole.

The interpretations drawn in this paper are based upon the modified Wealden delta scheme of stratigraphy and palaeoenvironments described by Lake and Thurrell (1974), after Allen (1959).

[1]Institute of Geological Sciences, 5 Princes Gate, London, SW7 1QN

The borehole was drilled by the Institute's own drilling rig. The cores were logged on site by R. D. Lake and P. Hildreth. A gamma log was run by P. D. Roberts of the Atomic Energy Division (now Geochemistry Division) of the Institute. Core recovery averaged 92 per cent. The description of rock colours is based on the Rock Color Chart of the Geological Society of America, the cores being dry when examined. Ostracod faunas have been identified by F. W. Anderson and are reviewed in Appendix 2.

Description of Lithologies and Sedimentary Structures

THE BASAL PART OF THE WEALD CLAY

This sequence is present to a depth of 44 ft (13.5 m). The upper part consists of alternating siltstones and silty mudstones. Both lithologies are predominantly grey in colour and bioturbated, showing local relict laminations. The lower 19 ft (5.8 m) of the mudstone sequence is silt laminated and has a sharp basal contact. These beds have no shelly fauna and the ironstones which outcrop in the reefs at Cooden are absent.

TUNBRIDGE WELLS SAND

Tunbridge Wells Sand was proved from 44 to 395 ft (13.5-120.4 m). The Grinstead Clay (Bristow and Bazley, 1972, p.34) is absent in the Hastings area and therefore the Tunbridge Wells Sand sub-group has not been subdivided, although there are some sedimentological similarities between occurrences in the Central Weald and on the east Sussex coast.

The junction of the Tunbridge Wells Sand and Weald Clay as seen in the field at Cooden (Osborne White, 1928, fig.11)—described as Wadhurst Clay overlying Ashdown Beds—is relatively sharp and well defined, in direct contrast to most of the Central Weald (Lake and Thurrell, 1974). Reference to the graphic log of the Cooden Borehole (Fig. 3) shows that this junction is not emphasised, due to lack of large scale contrast in the sediment grades near this horizon. Seen in detail, however, the contact of mudstone with underlying sandy siltstone is significantly sharp.

The Tunbridge Wells Sand is seen to consist of a complex cyclic sequence of siltstones with subordinate

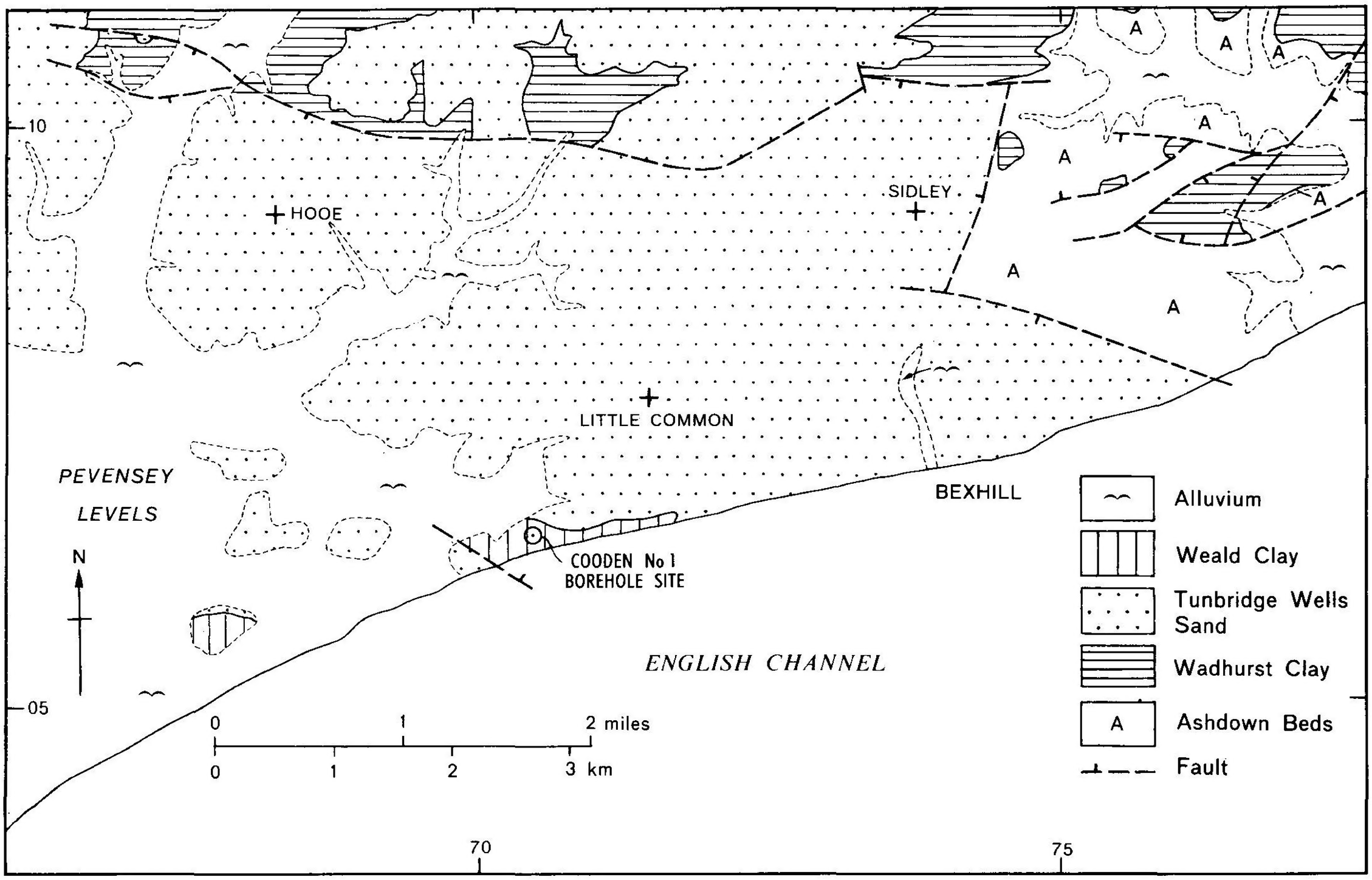


Fig. 1. Geological sketch-map of the Bexhill area

sandstones and mudstones. The degree of bioturbation is notably high, especially in the silts and mudstones, demonstrating a high activity of burrowing organisms or sediment 'grazers'. Plant debris is common throughout the formation. Coarsening upward cycles, which are bioturbated and/or striped, are evident down to 136 ft (41.5 m) depth in a predominantly rhythmic (siltstone/mudstone) sequence.

Pellet beds (mud-flake conglomerates) are common in the sequence from 136 ft to 275 ft (41.5 to 83.7 m), which is characterised by oscillatory gradation in grain size with a tendency to fining upwards. The pellet beds appear to have variably erosive or non-erosive bases. Well preserved rootlet beds occur at 192 ft (58.6 m) and 196 ft (59.7 m) and other indistinct rootlet beds are noted; these have a strong association with sphaerosiderite, which is first observed in abundance at 136 ft (41.5 m) depth in the borehole. Red mottling occurs at 240 to 242 ft (73.0 to 73.9 m) depth.

From 275 ft to 295 ft (83.7 to 90.0 m) a predominantly red and green mottled sequence of silts and mudstones occurs, similar to successions observed at Cuckfield in the Upper Tunbridge Wells Sand. The association with rootlets and sphaerosiderite is notable and crude colour lamination occurs at 290 ft (88.4 m). Bioturbation is evident at one horizon.

Below 295 ft (90.0 m) oscillatory gradation with a tendency to fine upwards is again noted. Only one pellet bed occurs within the sequence, at 351 ft (107.0 m) overlying a sandy siltstone which includes a root horizon. Sphaerosiderite is common below 347 ft depth (105.8 m).

The base of the Tunbridge Wells Sand is marked by a pellet bed at 394 ft 10 in (120.4 m).

Primary sedimentary structures within the formation are infrequently preserved, partly due to the high degree of bioturbation described above. Minor ripple drifting is evident at the top of the formation and locally elsewhere in the coarser grades. Minor cross-lamination is also rarely noted, but, apart from cross-bedding and slumping seen in association with a channel system floored by a pellet bed at 265 ft (80.9 m), there is little suggestion of a strongly active depositional environment. On the contrary, the evidence of fine lamination and bioturbation suggests almost totally quiescent conditions of sedimentation.

The fauna noted is as follows: ostracods at 254 to 255 ft (77.42 to 77.72 m) and 264 to 265 ft (80.47 to 80.77 m), *Euestheria* at 326 ft (99.4 m) and 335 ft (102.1 m), and ?bivalves at 272 ft (82.9 m) and 274 ft (83.5 m) (transported).

The presence of bitumen was noted at several levels in

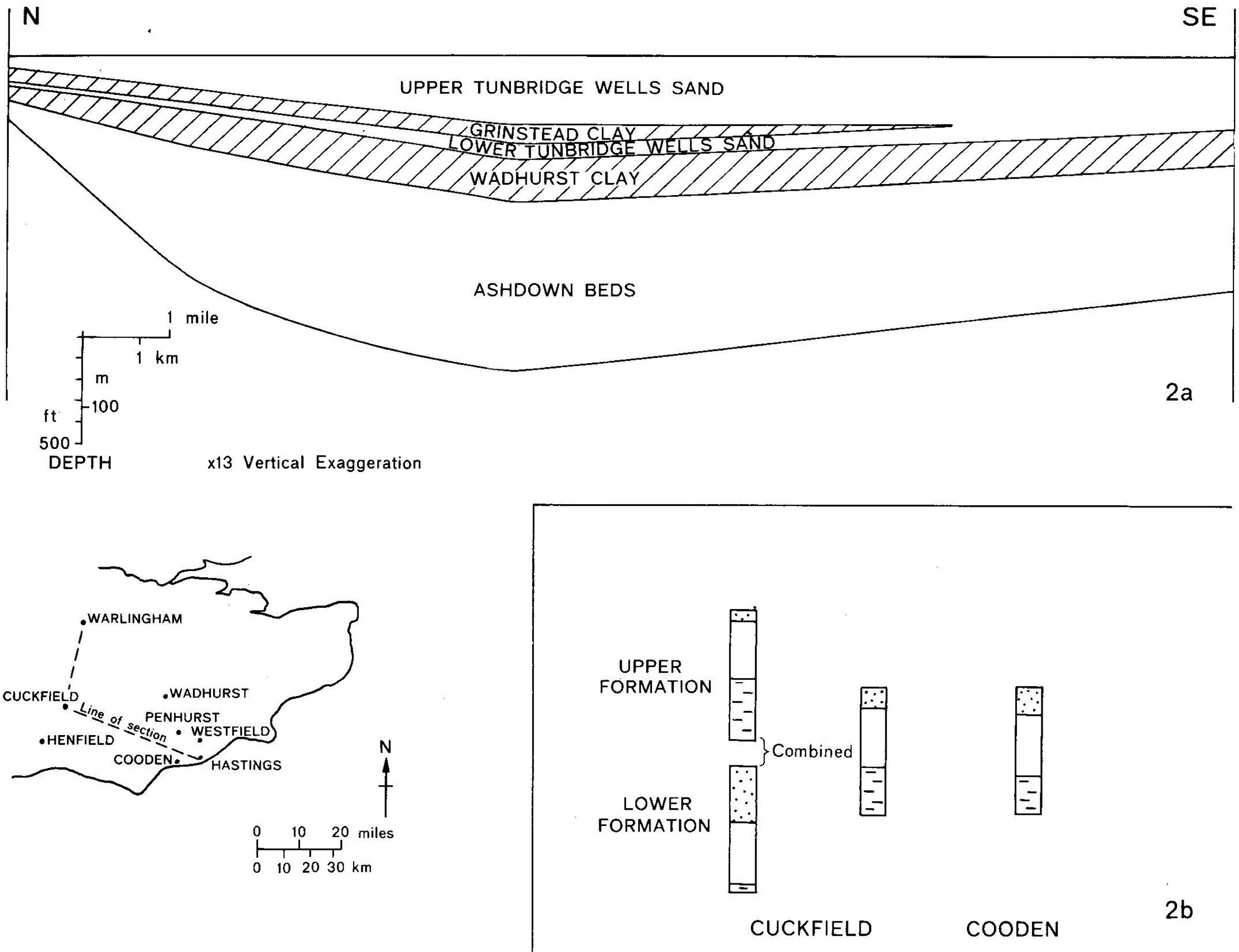


Fig. 2a. Diagrammatic section across the Hastings Beds of the Weald

Fig. 2b. Approximate ratios of sediment grades for the Tunbridge Wells Sand, (excluding the Grinstead Clay); stippled:sand, blank:silt, lined:clay

the Tunbridge Wells Sand, especially at the top. Oil sands in this formation have been reported from elsewhere in the Pevensey Levels area, namely at Chilley (Mantell, 1833, pp.172-173), Hailsham (Lees and Cox, 1937, p.156), Down Ash and at Rickney (Reeves, 1949, p.266). The association with faulting has been noted by Reeves (1949, p.267).

UPPER PART OF THE WADHURST CLAY

The upper part of the Wadhurst Clay was proved from 395 ft to 476 ft (120.4 to 145.0 m). In the Hastings area the formation consists predominantly of mudstones and shales, with subordinate siltstones and sandstones. The sandstones are, however, locally persistent: in particular, the topmost that was encountered in this borehole has been mapped as far east as Westfield and north to Penhurst.

The uppermost 18 ft (5.5 m) of the formation seen at Cooden is greenish grey, mottled red, in colour, in common with the upper beds elsewhere in the Weald (see Gallois, 1965). The green mudstones, which alternate with the typical grey lithology in the lower part of the sequence seen, are variably calcareous and display bioturbation structures from 407 to 413 ft (124.1 to 125.9 m). Shelly (*Neomiodon*) horizons occur below 407 ft (124.1 m) depth and consist of partings of disarticulated valves or isolated valves.

Rootlet beds occur at 427 ft (130.2 m) (within the sandstone unit), from 455 ft to 461 ft (137.7 to 140.6 m), and at 467 ft (142.4 m). In the second case, 10 in (0.25 m) of striped mudstone separated the rootlet horizon from an overlying shelly clay pellet bed. The association of

rootlet beds and overlying shell beds has been noted by Allen (1941) and Anderson and others (1967).

At 456 ft (139 m) a pellet clay horizon was noted which, unlike the examples seen at Cuckfield (see Lake and Thurrell 1974, p.5), is overlain by a rootlet bed, and not by barren mudstones.

The arenaceous bed (420 ft to 437 ft : 128.0 to 133.3 m) has a sharp top marked by a pebbly horizon and a rapid transitional base which is notably bioturbated but has in association a parting of mud pellets. Internally this unit is variably bioturbated or well laminated, with little evidence of an active depositional environment apart from one instance of ripple-drift bedding; changes of grain size are gradational. Rootlets and fish fragments occur at 427 ft (130.2 m) and at 430 ft (131.1 m) respectively. The mudstone bed below 437 ft (133.3 m) has sandy inclusions and is variably bioturbated. A basal pellet bed occurs at 448 ft (136.6 m).

Thin siltstones occur throughout the mudstone sequences; they rarely exceed one inch in thickness. On the smallest scale they give the characteristic 'striped' appearance to the mudstone lithology. The thicker siltstones occasionally exhibit small scale ripple drifting, channelling and rhythmic deposition.

The fault, which was penetrated by the borehole at 476 ft (145 m), is believed to be that which is observed at the surface on the foreshore reefs some 350 yds (320 m) south-west of the borehole site. Between these locations, shear zones have been observed in the foreshore reefs which would tend to suggest that the fault does not have the simple shallow-dipping plane that might perhaps be inferred. At the surface the fault throws a pellet bed horizon (very similar to those noted in the borehole at depths 235 ft (71.6 m) and 272 ft (83 m)), overlying mottled clays against Weald Clay. As the general regional dip is to the south-west, the fault possesses a throw of about the order of these last mentioned figures (see also Appendix 2, p.22). Since the Wadhurst Clay has a minimum thickness of 180 ft (54.9 m) in the area under consideration some 100 ft (30.5 m) of Wadhurst Clay and at least 135 ft (41.1 m) of Ashdown Beds are absent in the borehole sequence.

PART OF THE ASHDOWN BEDS

Ashdown Beds were proved from 476 to 546 ft (145.0 to 166.4 m). The sequence consists predominantly of siltstones with subordinate sandstones and mudstones. Coarsening upward cycles (less than 10 ft (3.0 m) in thickness) tend to dominate in these beds, which are generally strongly bioturbated. Pellet beds occur at 484 ft (147.4 m) (pebbly), 509 ft (155.3 m) and 541 ft (165.1 m).

Rare sedimentary structures include ripple drifting and minor channelling in the coarser grades, whereas mudcracks deformed by sediment compaction occur in the finer grades.

Rootlets are noted at 489 ft (149.1 m), 510 ft (155.4 m) and 520 ft (158.5 m) depths, apparently occurring at the tops of cycles with sphaerosiderite in close association.

Euestheria occur from 476 to 483 ft (145.1 to 147.2 m), ostracods were noted at 494 to 495 ft (150.5 to 150.8 m) and a ?bivalve at 525 ft 11 in (160.3 m).

Conclusions and Regional Implications

This paper is concerned primarily with the detailed lithologies of the Tunbridge Wells Sand that contrast quite strongly with those of the Central Weald (Lake and Thurrell, 1974). The most significant feature observed in the Wealden formations, as represented in the Cooden borehole, is perhaps the degree of bioturbation, discussed in detail below. The cyclic Tunbridge Wells Sand is on sedimentological grounds divided in the description into four parts which are necessarily somewhat arbitrary.

Coarsening upward cycles have been noted both from the Ashdown and Tunbridge Wells beds of Cooden and from the Upper Tunbridge Wells Sand of Cuckfield. The association of rootlets and sphaerosiderite with the top bed of some of these cycles is regarded as significant and may reflect a sedimentary pattern similar to that observed in the Coal Measures, for example, by Williams (1968, p.342) but less well developed. The presence of coarsening upwards cycles at the top of the Tunbridge Wells Sand at Cooden may be contrasted with the gradational sequence of fining upwards units seen at Cuckfield and the striped sequence of sandstone/mudstone alternations observed in the Warlingham Borehole (Worssam and Ivimey-Cook, 1971). The gradational passage of the Upper Tunbridge Wells to the Weald Clay at Cuckfield led Lake and Thurrell to conclude that no rapid transgressive phase was evidenced at this horizon. The absence of a transgressive lag deposit (comparable with the Ardingly Sandstone and top Ashdown Sandstone) at the other two sites would tend to confirm this.

The thickness of the Tunbridge Wells Sand at Cooden is 350 ft (106.7 m), compared with 505 ft (153.9 m) at Cuckfield, 143 ft (43.6 m) (faulted) at Warlingham, and 265 ft (80.0 m) (approximately) at Henfield (Taitt and Kent, 1958). The strong degree of bioturbation observed at Cooden, perhaps indicating a lower rate of clastic influx than at Cuckfield, is in agreement with these figures.

However, the Wadhurst Clay and Ashdown Beds do not show the same degree of attenuation from the Central Weald to the Hastings area (see Fig. 2a). It is possible, therefore, that part of the difference in thickness may be accounted for by basin subsidence, more particularly in Grinstead Clay times, reflected by its geographical distribution.

The approximate ratio of sediment grades of the Tunbridge Wells Sand at Cuckfield and Cooden is depicted in Fig. 2b. A comparative reduction of clay content is observed at Cooden and the contribution of the Ardingly Sandstone member (the upper part of the Lower Tunbridge Wells Sand) is seen to increase significantly the total sand content at Cuckfield. If this formation is regarded as a transgressive lag deposit, secondarily concentrated from the clastic influx to the basin, then the net deposition of coarse clastics was higher in the south-eastern Weald. It will be observed that the Grinstead Clay formation is omitted from the calculations of the sediment grades; its inclusion would

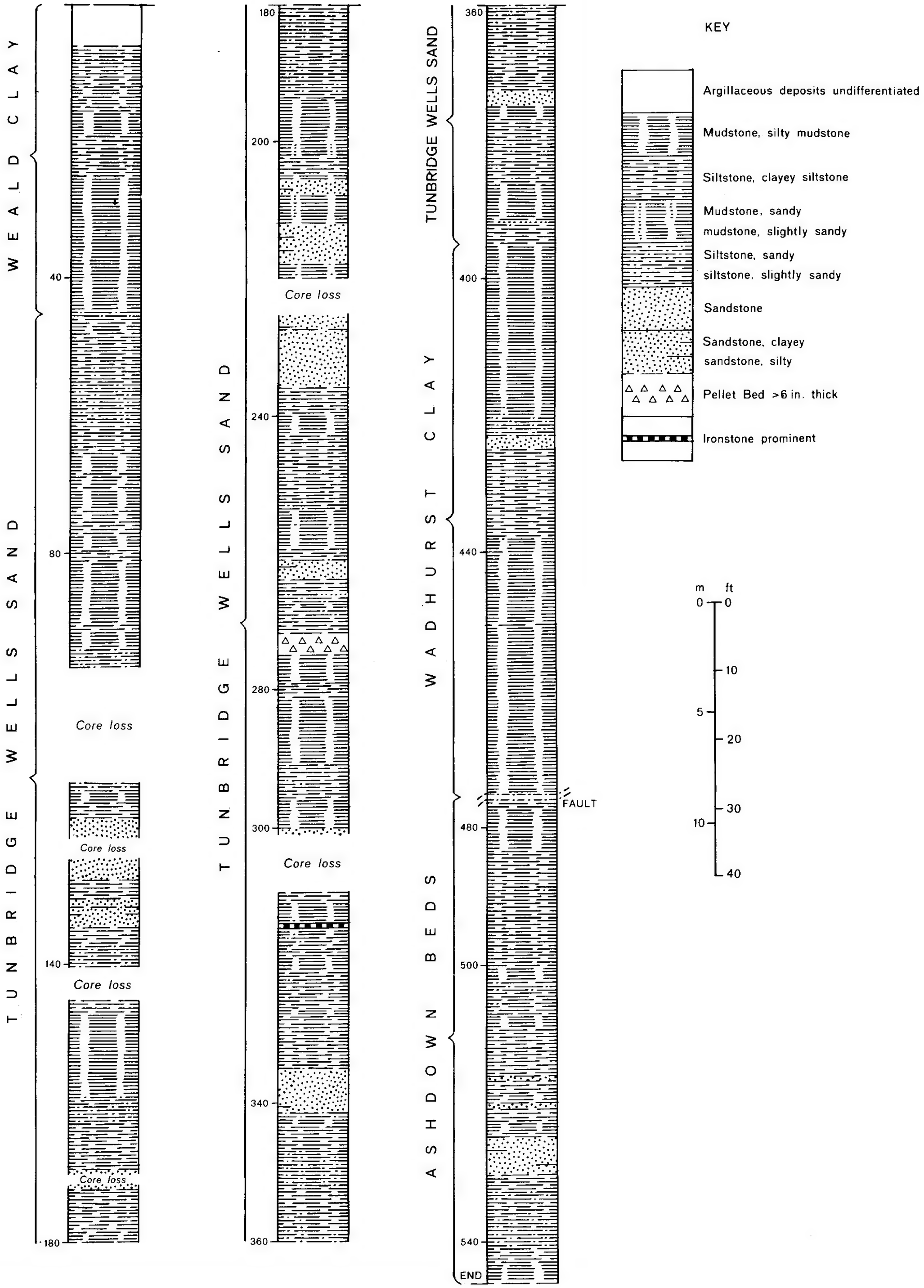


Fig. 3. Cooden No. 1 graphic log

further the coarse clastic bias to the Cooden area. Further evidence is required to define a vector for the source of the above sediments. A southerly source is suggested by the consistent development of the pro-deltaic Grinstead and Wadhurst Clays in northerly and lateral directions.

The red and green mottled silts and clays, although not restricted to any special stratigraphic horizon, occupy a fairly consistent zone in relation to the base of the Weald Clay in the Pevensey-Bexhill area.

In the region of Bexhill these beds occupy, and are cut by, channels with pellet strewn floors. In the Cooden Borehole, pellet beds with variously erosive and non-erosive bases occur in strata above the colour-mottled beds, indicating both channelling and reworking of sediments. Broadly speaking, there can be recognised, both at Cooden and at Cuckfield, the upward sequence: colour-mottled strata with pellet beds —— strata with pellet beds —— strata showing oscillatory cycles —— Weald Clay. Coincidentally perhaps, the mottled strata first appear approximately 200 ft (61 m) below the Weald Clay in both cases.

At Cuckfield the red and green mottled sequence passes down to the standard grey mudstones of the Grinstead Clay and may indicate a period of emergence concluding the 'basin facies' interval. It is tempting to correlate these mottled beds as indicating one diachronous emergent phase. If this were the case, emergence would have occurred at Bexhill (outside or peripheral to the Grinstead basin) at an earlier stage.

The sequence below the mottled beds at Cooden is similar to that immediately above them but shows increased bioturbation.

Viewing the Tunbridge Wells sequence as a whole, no great variation in sedimentary facies is evident and indeed the on-delta or alluvial plain model is most applicable to the environments of the formation as a whole. The emergent phase, which is reflected by the mottled clays, clearly re-invigorated channelling activity, but thereafter only a gradational passage to Weald Clay conditions is witnessed. The author, therefore, regards the environment of the Tunbridge Wells sequence at Cooden as essentially similar to that of the Upper Tunbridge Wells of Cuckfield, namely an on-delta alluvial plain tending to tidal flat; there was a breakdown of the Wealden delta sedimentary framework in Grinstead times (Lake and Thurrell, 1974). This conclusion carries the corollary that the Wealden delta did not advance over the Wadhurst Clay 'basin' but rather that a late-Wadhurst emergent phase had the effect of translating the 'delta front' northwards at least as far as the Central Weald. If this hypothesis is correct, emergent phases represented by the red/green mottled beds are possibly as significant as the transgressive sand bodies (capped by pebble beds) in demarcating environments.

The Wadhurst Clay sequence in the Hastings area is notable in containing arenaceous facies with characteristics closely resembling those of barrier bars (Shelton, 1967), namely gradational bases, sharp tops and local lateral continuity. Such deposits, which are indicative of peripheral-basin conditions, are significantly absent at Warlingham near the northern edge of the Wealden structural basin. Their presence throughout the Wadhurst Clay of the Hastings area, together with the occurrence of slumped sand bodies at Wadhurst (Anderson and others, 1967) and the absence of these at Warlingham all strongly suggest that the Wealden delta was northward facing.

The structures observed in the upper Ashdown Beds of the Hastings coast have been ascribed to delta-front conditions (Allen, 1960, p.11). Field mapping in the Brede Valley area to the north has demonstrated an essentially cyclic sequence with good lateral continuity of the individual lithologies (Lake, 1968). At Cooden the sequence has again been seen to be cyclic with coal-swamp affinities. The delta-front/on-delta environment reflected here contrasts with the delta slope conditions predominant at Cuckfield and the attenuated argillaceous (?pro-deltaic) sequence of Warlingham.

Acknowledgements

The author is grateful to his colleagues at the Institute of Geological Sciences for helpful comments on the manuscript.

Appendix 1: Log of Cooden Borehole No. 1

TQ 7043 0641
Surface level + c. 30 ft (9 m) O.D. 60 yd (55 m) S 74° W of Cooden Beach Station.

Core diameter 4 in; 3 in from 340 ft 8 in (103.8 m)

GSM specimen numbers BDB 905 to 1512. Colours logged as dry

Bitumen present in slight and variable concentrations from 44 ft 5 in to 50 ft 0 in (13.5 to 15.2 m)

Scale of bioturbation refers to size of mottles. Additional records of organic and sphaerosiderite content added from records of samples examined by Dr F. W. Anderson; rock classification by R. D. Lake.

Description of strata

	Thickness			*Depth*		
	ft	*in*	*m*	*ft*	*in*	*m*
Rock bit used to	5	10	1.78	5	10	1.78
WEALD CLAY						
Siltstone, clayey, light olive grey (5Y6/1) mottled ochreous. Soft, friable, probably laminated originally.	4	0	1.22	9	10	3.00
Siltstone, light olive grey (5Y5/2). Finely laminated. Plant debris.	0	8	0.20	10	6	3.20
Mudstone, slightly silty, light olive grey (5Y5/2). Passing down into	0	4	0.10	10	10	3.30
Siltstone, very light grey (N8) weathering ochreous. Local light olive grey mudstone partings initially. Plant debris and worm casts.	1	2	0.36	12	0	3.66
Mudstone, silty, medium light grey (N6). Bioturbated, with 'blebs' of light grey silt. Fine partings of silt up to 1/10 in (2 mm). Passing down into	1	2	0.35	13	2	4.01
Siltstone, clayey, light grey (N7). Bioturbated. Passing down into	0	5	0.13	13	7	4.14
Mudstone, medium light grey (N6). Bioturbated, with 'blebs' of very light grey silt, faintly colour mottled on partings. Tending to laminated at 14/0 (4.27 m).	1	1	0.33	14	8	4.47
Siltstone, clayey, light grey (N7). Bioturbated. Plant debris. Passing down into	0	10	0.25	15	6	4.72
Mudstone, silty. Medium light grey (N6) tinged olive. Bioturbated, with 'blebs' of very light grey silt. Very silty at 16/6 (5.03 m). Ochreous silty laminations to 1/10 in (2 mm) at 18/5 (5.61 m) (slightly inclined). Very finely laminated from this depth. Plant debris and worm casts. Sharp contact at base.	3	6	1.07	19	0	5.79
Siltstone, light grey (N7). Hard, bioturbated. Tending to clayey at 20/0 (6.10 m). Locally very clayey from 20/6 (6.25 m). Finely laminated from 22/5 (6.83 m) to 23/0 (7.01 m). Plant debris at 22/0 (6.70 m). Worm casts.	4	4	1.32	23	4	7.11
Mudstone, very silty. Medium grey (N5). Fine laminations of silt. Partly bioturbated.	0	8	0.21	24	0	7.32
Siltstone, light olive grey (5Y6/1). Bioturbated. Tending to clayey at 25/0 (7.62 m). Laminated at 24/9 (7.54 m).	1	0	0.30	25	0	7.62
Mudstone, silty. Laminated. Greenish grey (5GY6/1) initially. Very silty from 27/0 (8.23 m) and bioturbated. Tends to medium light grey (N5-6) olive tinged from 26/3 (8.00 m). Plant fragments at 29/9 (9.07 m). Less silty from 32/8 (9.96 m). Variably laminated from 30/3 (9.22 m) to 31/3 (9.53 m). Siltier from 33/3 (10.13 m) to 33/6 (10.21 m). Tends to greenish grey at c.34/0 (10.36 m). Very silty from 35/5 (10.80 m) to 35/9 (10.90 m). Silt laminated from 37/3 (11.35 m) to 37/5 (11.40 m). Carbonaceous fragments at 38/6 (11.73 m). Very silty, showing relict laminations from 39/10 (12.14 m) to 40/3 (12.27 m), with rootlets. Patchily laminated between 42/0 (12.80 m) and 43/0 (13.11 m). Increasingly silty to base. Sporadic fish debris. Sharp contact at base.	19	5	5.92	44	5	13.54
TUNBRIDGE WELLS SAND						
Siltstone, sandy, light olive grey (5Y6/1), finely clay laminated. Micro cross-bedding. Very friable.	1	1	0.33	45	6	13.87
Siltstone, light grey (N7), very friable, variably striped with mudstone. Patchily bioturbated. Finely laminated on a small scale. Some plant debris. Passing down into	1	2	0.35	46	8	14.22
Mudstone, medium grey (N5) tinged olive. Variably bioturbated or striped with silt. Plant fragments.	0	11	0.28	47	7	14.50
Siltstone, light grey (N7). Very friable, striped with mudstone, finely						

	Thickness ft	in	m	Depth ft	in	m
laminated on a micro-scale but variably bioturbated. Plant fragments. Very clayey between 50/8 (15.44 m) and 52/11 (16.13 m). Tends to sandy at c.53/0 (16.15 m) and 54/0-6 (16.46-16.56 m), finely laminated.	7	7	2.31	55	2	16.81
Siltstone, sandy, light grey (N7), very friable. Consists of very fine sand interbedded on a large and small scale with medium light grey (N6) clayey silt. Bioturbated at 57/4 (17.48 m). Burrows common to 59/0 (17.98 m). Ripple-drift bedding. Slightly bituminous locally in silty fraction, particularly 58/4 (17.78 m) to 58/6 (17.83 m). Few carbonaceous fragments. Passing down into	5	10	1.78	61	0	18.59
Siltstone, light grey (N7) striped with clayey siltstone, greenish grey (5GY6/1). Friable. Finely laminated, ripple drift bedding. Burrows at 62/3 (18.97 m), bioturbated at 63/0 (19.20 m) and 63/7 (19.38 m). Fish debris.	4	6	1.37	65	6	19.96
Mudstone, silty, medium grey (N5). Tending to laminated initially but generally bioturbated, burrows picked out by silt. Passing down into	0	10	0.26	66	4	20.22
Siltstone, very light grey (N8). Bioturbated. Passing down into	0	3	0.07	66	7	20.29
Mudstone, light grey (N7) sub-fissile. Bioturbated to 66/8 (20.32 m) then finely laminated with silt. Tends to greenish-grey (5GY6/1), waxy from 67/0 (20.42 m); pyrite. Sharp base at	1	5	0.44	68	0	20.73
Siltstone, very light grey (N8), striped with light grey (N7) mudstone, friable. Finely laminated, tends to bioturbated at base. Carbonaceous fragments. Passing down into	0	8	0.20	68	8	20.93
Mudstone, silty, greenish grey (5G6/1). Finely silt laminated, weakly bioturbated. Carbonaceous fragments, especially at the top. Passing down into	1	4	0.41	70	0	21.34
Siltstone, very light grey (N8). Bioturbated initially then striped, with carbonaceous fragments. Cluster of flattened pyrite nodules at 70/5. Passing down into	0	7	0.17	70	7	21.51
Mudstone, silty, greenish grey (5GY6/1). Bioturbated to 70/8 (21.54 m) then striped, becoming bioturbated from 70/11 (21.62 m). Laminated from 72/6 (22.10 m). Plant fragments at 72/3 (22.02 m). Very silty towards sharp base at	2	10	0.87	73	5	22.38
Siltstone, clayey, very light grey (N8) to light grey (N7). Finely laminated. Plant fragments. Passing down into	0	4	0.10	73	9	22.48
Mudstone, very silty, greenish grey (5GY6/1) tending to light grey (N7) from 74 ft (22.56 m). Greenish grey (5GY6/1) from 74/11 (22.83 m). Bioturbated generally but tending to laminated from 74/7 (22.73 m) to 75/2 (22.91 m). Passing down into	1	6	0.46	75	3	22.94
Siltstone, clayey, light grey (N7). Bioturbated initially, laminated from 75/9 (23.09 m). Passing down into	0	9	0.22	76	0	23.16
Mudstone, very silty, medium grey (N5) tinged olive, laminated with very light grey (N8) silt. Slightly bioturbated. Passing down into	0	7	0.18	76	7	23.34
Siltstone, clayey. Laminated, slighted bioturbated. Passing down into	0	7	0.18	77	2	23.52
Mudstone, very silty, medium light grey (N6). Striped with silt, a few burrows. Bioturbated at base. Passing down into	1	10	0.56	79	0	24.08
Siltstone, clayey, light grey (N7), bioturbated, homogeneous. Vaguely laminated from 80 ft (24.38 m), distinctly so from 80/3 (24.46 m). Bioturbated at base. Plant fragments. Passing down into	2	0	0.61	81	0	24.69
Mudstone, very silty, light grey (N7) tinged olive, bioturbated, tending to laminated from 82 ft (24.99 m) to 85 ft (25.91 m). Tends to greenish grey (5G6/1). Less silty below 83 ft (25.30 m). Burrows at 83/10 (25.55 m). Plant fragments at 84/9 (25.83 m). Laminated from 86/3 (26.29 m) to 86/10 (26.47 m). Relict striping (to ¼ in (6.4 mm)) evident from 87/4 (26.62 m). Less silty from 87/8 (26.72 m), tending to laminated. Increasingly silty from 88/8 (27.03 m). Passing down into	9	0	2.74	90	0	27.43
Siltstone, clayey, very light grey (N8), laminated. Plant fragments. Tends to bioturbated, greenish grey (5GY6/1) from 90/6 (27.58 m).	0	9	0.23	90	9	27.66
Mudstone, very silty, light olive grey (5Y6/1). Bioturbated, tending to laminated from 92 ft (28.04 m), siltstone bands to ¼ in (6.4 mm). Basal contact obscure.	2	10	0.86	93	7	28.52
Siltstone, sandy, yellowish grey (5Y8/1). Finely laminated with darker clayey partings. Lamination inclined to 40° initially, thereafter flat. Finer grained, some bioturbation from 94/6 (28.80 m). Carbonaceous fragments at 94/9 (28.88 m). Weak lamination from 95/0 (28.96 m). Coarser grained from 95/3 (29.03 m). Bioturbated from 95/9 (29.18 m), tending to light olive grey. Finer grained from 96/3 (29.34 m), tending to medium grey (N5). Plant fragments common from 95/11 (29.24 m).	3	0	0.92	96	7	29.44

	Thickness			Depth		
	ft	*in*	*m*	*ft*	*in*	*m*
Mudstone, very silty, dark greenish grey (5GY4/1). Homogeneous.	0	2	0.05	96	9	29.49
Core lost (believed to be soft sand)	16	9	5.10	113	6	34.59
Siltstone, sandy, medium grey (N5). Soft, friable. Very light grey (N8) sand occurs as fine partings within slightly bioturbated silts. Plant debris. Passing down into	0	10	0.26	114	4	34.85
Siltstone, clayey, medium grey (N5). Bioturbated. Carbonaceous fragments. Passing down into	0	3	0.08	114	7	34.93
Mudstone, very silty, medium grey (N5) tinged olive, massive. Mainly homogeneous with silty wisps. Passing down into	1	5	0.43	116	0	35.36
Siltstone, clayey, light olive grey (5Y6/1), hard, massive. Vaguely laminated, locally striped to ½ in (12.7 mm) with very silty mudstone. Lamination lost at 117 ft (35.66 m). Softer from 116/8 (35.56 m) to 117 ft (35.66 m). Sporadic relict laminations below 117/6 (35.81 m). Many plant fragments. Sharp base at	2	8	0.81	118	8	36.17
Sandstone, slightly clayey, light olive grey (5Y6/1) tending to greenish, friable. Local carbonaceous wisps. Slightly coarser from 120 ft (36.58 m).	3	0	0.91	121	8	37.08
Core lost (believed to be soft sand)	3	0	0.91	124	8	37.99
Sandstone, as above but harder, well laminated. Less clayey from 125/9 (38.30 m) to 126/1 (38.43 m), cross-lamination evident. Common carbonaceous wisps. Finer grained from 126/6 (38.56 m) with sphaerosiderite. Bioturbated below 126/7 (38.58 m). Passing down into	2	4	0.72	127	0	38.71
Siltstone, clayey, yellowish grey (5Y8/1). Bioturbated, showing relict lamination. More massive below 127/9 (38.94 m). Finely laminated at 128/6 (39.17 m). Slightly more clayey below 129/6 (39.47 m). Plant debris. Sharp base at	3	2	0.96	130	2	39.67
Sandstone, medium to fine grained, mottled white (N9) and greyish yellow green (5GY7/2). Becoming clayey from 130/6 (39.78 m). Plant debris and sphaerosiderite. Passing down into	0	10	0.26	131	0	39.93
Mudstone, sandy, mottled light olive grey (5Y5/2), light grey (N7) and yellowish grey (5Y8/1). Bioturbated. Passing down into	0	6	0.15	131	6	40.08
Sandstone as above. Also streaked light grey (N7). Sphaerosiderite.	0	8	0.20	132	2	40.28
Mudstone/Sandstone striped. Mudstone is greenish grey (5GY6/1) in colour. Burrowed initially. Some rippling.	0	3	0.08	132	5	40.36
Sandstone, medium to fine grained, light grey (N7). Finely laminated with mudstone as above. 2 in mudstone at 132/10 (0.05 at 40.49 m). Lamination less distinct below 133 ft (40.54 m). A ½ in mudstone (12.7 mm) at 133/4 (40.64 m). Clay galls to ¼ in (6.4 mm) to 133/6 (40.69 m). Laminae disturbed and broken from 133/6 to 7 (40.69 to 40.72 m). Plant fragments at 133/9 (40.77 m). Sphaerosiderite. Seen to	1	5	0.43	133	10	40.79
Core lost	0	2	0.05	134	0	40.84
Sandstone, fine grained, yellowish grey (5Y8/1). Finely laminated with mudstone.	0	2	0.05	134	2	40.89
Siltstone, very light grey (N8). Finely laminated with medium light grey (N6) mudstone. Slightly bioturbated at 134/3 and at 134/7 (40.92 and at 41.02 m). Rippling at 134/10 (41.10 m). Tends to sandy from 135/0 to 135/3 (41.15 to 41.22 m). Bioturbated from 135/3 (41.22 m). Relict laminations from 135/6 (41.30 m). Passing down into	2	0	0.61	136	2	41.50
Mudstone, very silty, light grey (N7), massive. Bioturbated, tends to laminated at base.	0	2	0.05	136	4	41.55
Pellet Bed. Dark greenish grey (5G4/1) streak at top. Sphaerosiderite. Pellets of silt (c.¼ in) (6.4 mm) in basal ¾ in (19.1 mm) in clayey matrix as below.	0	2	0.06	136	6	41.61
Mudstone, silty, olive grey (5Y4/1), homogeneous. Carbonaceous fragments. Erosive base.	0	3	0.07	136	9	41.68
Siltstone, sandy, very light grey (N8) greenish tinged, friable. Bioturbated, relict clay lamination evident from 137 ft (41.76 m). Becoming finer grained from 137/6 (41.91 m). Seen to	3	2	0.97	139	11	42.65
Core lost (believed to be soft sand)	5	1	1.55	145	0	44.20
Siltstone, clayey, medium light grey (N6), strongly massive below 146 ft (44.50 m). Bioturbated, relict laminations from 145/9 (44.42 m). Plant fragments. Slightly bituminous at 146 ft (44.50 m). Sharp base at	1	8	0.50	146	8	44.70
Mudstone, very silty, light grey (N7), slightly micaceous locally, massive. Generally bioturbated, relict lamination locally. Tending						

	Thickness			Depth		
	ft	*in*	*m*	*ft*	*in*	*m*
to greenish in colour from 148 ft (45.11 m). Light olive grey (5Y6/1) from 149 ft (45.42 m). Medium grey (N5) from 149/6 to 151/0 (45.57 to 46.03 m). Light olive grey (5Y6/1) from 151 ft (46.03 m). Becoming siltier. Sandy pocket at 152/7 to 2 in (46.51 to 0.05 m) thick. Continuing bioturbated, homogeneous with sporadic coarse silt laminations (originally striped to c.1 in (25.4 mm) with siltier material). Fish debris from 150/0 to 154/0 (45.72 to 46.93 m). Mudstone tends to less silty and medium dark grey (N4) with carbonaceous sandy lenses in basal 3 in (0.08 m). Pellets of very fine sand to 1 in (25.4 mm) in basal ½ in (12.7 mm). ?Non-erosive base.	12	4	3.76	159	0	48.46
Sandstone, yellowish grey (5Y8/1) tending to ochreous, coarse initially, containing wisps of medium dark grey (N4) mudstone to 1 in (25.4 mm). Tending to silty with sharp carbonaceous base at	0	1	0.03	159	1	48.49
Siltstone, medium grey (N5) tinged olive, massive. Bioturbated with sporadic relict laminations. Carbonaceous. Clayey to 159/2 (48.51 m), tending to sandy from 159/8 to 160/0 (48.67 to 48.77 m), locally finely laminated. Sandy from 160/4 (48.87 m), well laminated, only slightly bioturbated. Increasingly bioturbated from 162 ft (49.38 m). Basal contact not seen.	3	3	0.99	162	4	49.48
Siltstone, clayey, mottled light greenish grey (5G8/1) and very light grey (N8). Massive, bioturbated (fine mottles) tends to paler green, below 163/6 (49.83 m). Cylindrical silt-filled cavities at 165 ft (50.29 m). More clayey from 165/7 (50.47 m) with relict laminations. Larger bioturbation structures below 166/1. Passing down into	4	3	1.29	166	7	50.77
Siltstone, clayey, light grey (N7) tending to medium light grey (N6), bioturbated, massive. Carbonaceous fragments. Relict laminations and abundant carbonaceous fragments at 167/6 (51.05 m). 1 in (25.4 mm) greenish grey (5GY6/1) very silty mudstone at 168/5 (51.33 m). Fairly sharp base at	2	2	0.66	168	9	51.43
Mudstone, very silty, dark greenish grey (5GY4/1), massive, homogeneous. Listric surface. Sphaerosideritic, strongly at base. Sharp base at	0	5	0.13	169	2	51.56
Siltstone, light grey (N7) tending to sandy at 169/3 (51.59 m). Bioturbated. Filamentous rootlets.	0	3	0.08	169	5	51.64
Sandstone, medium grained, very light grey (N8), sphaerosideritic, slightly micaceous, friable. Passing down into	0	2	0.05	169	7	51.69
Pellet bed, sandy matrix, pellets to ½ in (12.7 mm) of fine grained ochreous sandstone. Dusky yellow green (5GY5/2) coloration developed patchily. Sphaerosiderite.	0	2	0.05	169	9	51.74
Sandstone, as above, vaguely laminated. Tending to greyish yellow green (5GY7/2) at base. Seen to	0	3	0.08	170	0	51.82
Core lost	1	9	0.53	171	9	52.35
Sandstone, fine grained, slightly clayey, greyish green (5GY6/1), friable. Carbonaceous streaks. Sharp base at	0	4	0.10	172	1	52.45
Siltstone, very light grey (N8) tending to light grey (N7) locally, massive, bioturbated with local relict laminations. Slightly sphaerosideritic initially. Carbonaceous fragments. Tends to clayey, well laminated, medium light grey (N6) in clay fraction from 175 ft (53.34 m). 20° depositional dip at 176/3 (53.72 m). Local sphaerosiderite. Passing down into	4	11	1.50	177	0	53.95
Mudstone, very silty, light to medium light grey (N8-7). Finely laminated, bioturbated within partings. Basal contact not seen at	0	8	0.20	177	8	54.15
Siltstone, very clayey, olive grey (5Y4/1), homogeneous, massive. Plant debris, very carbonaceous. Passing down into	0	11	0.28	178	7	54.43
Mudstone, very silty, medium light grey (N6), finely laminated with silt. Passing down into	1	1	0.33	179	8	54.76
Siltstone, light olive grey (5Y6/1). Generally well laminated. Tending to sand laminated from c.180/0 to 185/0 (54.86 to 56.39 m). A 1 in (25.4 mm) pyrite nodule at 180 ft (54.86 m). Slightly bioturbated from 181 ft (55.17 m). Sand laminated from 187/6 (57.15 m). Local carbonaceous fragments.	11	4	3.46	191	0	58.22
Siltstone, sandy, very light grey (N8), tending to massive. Vaguely laminated. Root cavities with carbonaceous linings filled with sand, carbonaceous fragments (?seat earth). ?Sharp base at	1	3	0.38	192	3	58.60
Siltstone, clayey, light olive grey (5Y6/1), finely laminated. Passing down into	1	4	0.40	193	7	59.00
Mudstone, silty, light grey (N7). Finely laminated with silt. Less silty toward base. Sharp ¼ in (6.4 mm) sandy parting at base at	1	0	0.31	194	7	59.31
Mudstone, very silty, yellowish grey (5Y7/2) tending to light grey (N7)						

	Thickness			Depth		
	ft	in	m	ft	in	m
from 196/0 to 197/0 (59.74 to 60.05 m). Massive, bioturbated with local fine laminations. Many pyritic rootlets. Large roots to ¼ in (6.4 mm) diameter. Ironstone nodules to 2 in from 196 ft (0.05 m from 59.74 m). Sphaerosiderite at c.196 ft (59.74 m). Worm casts 194/0 to 195/0 (59.13 to 59.43 m). Carbonaceous fragments, plant fragments. Roots absent below 198 ft (60.35 m). Slightly sandy from 199 ft (60.66 m). Passing down into	5	8	1.73	200	3	61.04
Mudstone, sandy, light olive grey (5Y6/1), hard, massive, bioturbated, locally laminated. Carbonaceous fragments. Passing down into	1	9	0.53	202	0	61.57
Siltstone, light grey (N7), hard, massive. Bioturbated with local sandy partings and relict laminations. Carbonaceous. Tending to clayey from 204 ft (62.18 m).	2	4	0.71	204	4	62.28
Mudstone, silty, medium grey (N5) with sandy partings. Generally laminated, bioturbated in part. Passing down into	1	2	0.36	205	6	62.64
Sandstone, very light grey (N8), with clayey partings (some lensed). Locally thick sandy mudstone bands to 1 in (25.4 mm). Slight bioturbation. Passing down into	2	2	0.66	207	8	63.30
Mudstone, silty as above with sandy pods and partings to 211 ft (64.31 m). Continues with fine laminations of coarse silt. Tends to massive from 212 ft (64.62 m). ?Passing down into	4	7	1.39	212	3	64.69
Sandstone, fine grained, very light grey (N8) with light olive grey (5Y6/1) mudstone partings to ¼ in (6.4 mm). Carbonaceous partings and fragments (1/6 (0.46 m) recovery from 213/0 to 217/1 (64.92 to 66.17 m)). Passing down rapidly into	5	3	1.60	217	6	66.29
Mudstone, medium light grey (N6) with sand and fine (subordinate) silt partings. Slightly bioturbated. 3 in (0.08 m) sandstone at 218/0 to 218/3 (66.45 to 66.52 m). Minor rippling. A 3 in (0.08 m) sandstone at 219/3 to 219/6 (66.83 to 66.90 m). Carbonaceous partings.	2	7	0.79	220	1	67.08
Core lost (believed to be soft sand)	5	0	1.53	225	1	68.61
Sandstone, fine grained, very light grey (N8), with fine mudstone partings. Strong carbonaceous partings and wisps. A 1 in (25.4 mm) olive grey (5Y4/1) mudstone at 227/0 to 227/1 (69.19 to 69.22 m). Parting of carbonaceous (wood) fragments at sharp base at	2	1	0.63	227	2	69.24
Siltstone, clayey, olive grey (5Y4/1), bioturbated, carbonaceous initially. Light grey (N8), vaguely laminated with very silty mudstone, olive grey (5Y4/1) from 227/4 (69.29 m), tending to sand laminated, less clayey. Slightly micaceous (4/9 (1.45 m) core lost on run 227/1 to 234/0 (69.22 to 71.32 m)).	?0	6	0.15	?227	8	69.39
Sandstone, fine grained, very light grey (N8). Mudstone partings to 1 in (25.4 mm), variably bioturbated. Silt laminated at base. Carbonaceous fragments. (4/9 (1.45 m) core lost on run 227/1 to 234/0 (69.22 to 71.32 m)).	6	7	2.01	234	3	71.40
Pellet bed, sandy matrix, yellowish grey (5Y8/1), hard, massive. Pellets of greenish silt to ¾ in (19.1 mm). Many carbonaceous fragments.	0	6	0.15	234	9	71.55
Sandstone, very light grey (N8) mottled light olive grey (5Y6/1). Carbonaceous fragments and partings. Tends to silty, bioturbated at base. Medium light grey (N6), mudstone galls to 2 in (0.05 m) at sharp base.	0	11	0.28	235	8	71.83
Mudstone, very silty, medium light grey (N6), hard, massive, bioturbated. Few pellets of creamish silt to ½ in (12.7 mm) in top 2 in (0.05 m). Passing down into	0	4	0.10	236	0	71.93
Siltstone, light grey (N7), hard, massive, bioturbated. Tends to greenish grey (5GY6/1) at base. Ostracods. Passing down into	3	6	1.07	239	6	73.00
Mudstone, very silty, light olive grey (5Y6/1), tending to light olive grey (5Y5/2). Small scale mottled moderate red and dusky yellow (5Y6/4) on medium light grey (N6) from 240/4 to 242/0 (73.25 to 73.76 m). Light grey (N7) to base. Bioturbated with local relict laminations initially. Sphaerosiderite. Passing down into	2	11	0.89	242	5	73.89
Siltstone, clayey, light grey (N8), hard, massive, bioturbated. Burrow infills of clay material. Fine rootlet traces coloured yellowish green.	1	10	0.56	244	3	74.45
Pellet bed, silty matrix as above. Pellets of green silty mudstone up to ¼ in (6.4 mm).	0	1	0.02	244	4	74.47
Siltstone, clayey, light grey (N7), hard, massive, bioturbated with traces of relict lamination. Tends to olive mottled. Clayey galls to 244/10 (74.63 m). Sphaerosiderite from 246/0 to 248/0 (74.98 to 75.59 m) and 249/0 to 250/0 (75.90 to 76.20 m). Distinctly ochreous mottled from 248/6 (75.74 m) on ?rootlet traces. Mottling lost below 250/6 (76.35 m). Tending to medium light grey (N6) with carbonaceous fragments. Vaguely laminated below 251/6 (76.66 m), carbonaceous						

	Thickness			Depth		
	ft	*in*	*m*	*ft*	*in*	*m*
laminae, less clayey tending to sandy. Bioturbated base at	9	2	2.80	253	6	77.27
Mudstone, very silty, medium light grey (N6), hard, massive, bioturbated, homogeneous. Ostracods to 255 ft (77.72 m). Tends to sandy below 254/6 (77.57 m). Vaguely laminated at c.256 ft (78.03 m), very sandy from 256/4 to 256/8 (78.13 to 78.23 m) with relict lamination. Finely laminated from 256/8 (78.23 m), with plant fragments, tending to colour banded on ½ in (12.7 mm) scale, light olive grey (5Y6/1) and light grey (N7). Lamination lost below 257/9 (78.56 m), continuing vaguely colour banded.	5	3	1.60	258	9	78.87
Siltstone, very light grey (N8), hard, massive, bioturbated, weakly laminated, carbonaceous fragments. Clayey striping at 259/6 (79.10 m) shows depositional dip to 20°. Sharp bioturbated base at	1	1	0.33	259	10	79.20
Mudstone, silty, olive grey (5Y4/1) initially, tending to dark greenish grey (5GY4/1). Vaguely colour banded dark greenish grey and light olive grey (5Y6/1) from 260 ft (79.25 m). Bioturbated. Relict fine lamination at c.260/3 (79.32 m). Sharp base at	0	8	0.20	260	6	79.40
Siltstone, banded olive grey (5Y4/1) and light olive grey (5Y6/1), with lenses of fine sand to ¼ in (6.4 mm) thick. Variably bioturbated to finely laminated. Carbonaceous fragments. Tends to sandy below 260/10 (79.50 m). Passing down into	0	6	0.15	261	0	79.55
Sandstone, fine grained, very light grey (N8), slightly micaceous. Olive grey (5Y4/1) mudstone partings, to ½ in (12.7 mm). Carbonaceous wisps and fragments. Medium grained from 261/2 (79.60 m). A 2 in (0.05 m) mudstone at 261/10 to 262/0 (79.81 to 79.86 m) and at 262/2 to 262/4 (79.91 to 79.96 m). Mudstone partings rare below 262/4 (79.96 m). Carbonaceous wisps and laminations abundant, showing depositional dips to 45°. Current bedded below 262 ft (79.86 m). Fine grained below 263 ft (80.16 m). Passing down rapidly into	2	9	0.84	263	9	80.39
Siltstone, light olive grey (5Y6/1), hard, massive, bioturbated. Many carbonaceous fragments and rare wisps, laminae below 264/6 (80.62 m). Rare ochreous pellets to ⅛ in (3.2 mm). Striped with mudstone from 264/6 to ½ in (80.62 m to 12.7 mm). Large wood fragments from 264/6 (80.62 m). A 3 in (0.08 m) slump lobe of silt material at 264/8 (80.67 m). Ostracods. Sharp base at	1	5	0.43	265	2	80.82
Pellet bed, medium grained sandy matrix, very light grey (N8). Pellets of ochreous silt to ⅛ in (3.2 mm), green mudstone to ½ in (12.7 mm). Carbonaceous wisps, ½ in (12.7 mm) mudstone at top. Very irregular channelled base at	0	3	0.08	265	5	80.90
Sandstone, silty, light olive grey (5Y6/1) striped with medium grey (N5) mudstone to ¼ in (6.4 mm). Passing down into	0	5	0.13	265	10	81.03
Siltstone, clayey, yellowish grey (5Y8/1) to light grey (N7), hard, massive, variably bioturbated to laminated, carbonaceous fragments. Tending to sandy from 266/6 to 266/10 (81.23 to 81.33 m) then striped with sand, well laminated below 266/6 (81.23 m). Tends to more clayey below 267 ft (81.38 m). Passing down into	1	5	0.43	267	3	81.46
Mudstone, very silty, light grey (N7) to light olive grey (5Y6/1), locally finely laminated. Passing down into	0	9	0.23	268	0	81.69
Siltstone, clayey, light grey (N7) striped with medium grey (N5) mudstone. Generally finely laminated, slightly bioturbated. Sandy partings to ¼ in (6.4 mm). Plant fragments. Sphaerosiderite. Tends to clayey near base with ¼ in (6.4 mm) silty mudstone parting at sharp base.	3	2	0.96	271	2	82.65
Pellet bed, sandy matrix, greenish silty mudstone pellets to ⅛ in (3.2 mm). Carbonaceous wisps at indistinct base.	0	1	0.03	271	3	82.68
Siltstone, very clayey, light olive grey (5Y6/1). Fine sand laminae from 271/3 to 271/4 (82.68 to 82.70 m). Sharp base at	0	3	0.07	271	6	82.75
Pellet bed, ochreous, sandy matrix. Greenish silty mudstone pellets to ½ in (12.7 mm), ironstone pellets to ¾ in (19.1 mm). Much plant debris initially continuing carbonaceous. ½ in (12.7 mm) ironstone lens at 272 ft (82.91 m). Local pellet-free silty zones. Local carbonaceous partings. Pellets show fine listric structures internally. Sharp irregular base at	3	1	0.94	274	7	83.69
Mudstone, silty, greenish grey (5GY6/1) massive, homogeneous. Many listric surfaces initially. Tends to siltier, light grey (N7) with local listric surfaces, finely bioturbated. Rare sphaerosiderite. Passing down into	3	11	1.20	278	6	84.89
Siltstone, very clayey, light olive grey (5Y6/1), tinged green initially, locally mottled greyish red (5R4/2) in clayey parts. Hard, massive, homogeneous, bioturbated. Rare sphaerosiderite. Passing down into	2	4	0.71	280	10	85.60
Mudstone, silty, mottled greyish red (5R4/2) (tending to dusky red						

	Thickness			Depth		
	ft	in	m	ft	in	m
(5R3/4)) and moderate reddish brown on greenish grey (5GY6/1), massive, variably hard. Many listric surfaces. Strongly sphaerosideritic from 283/6 to 287/6 (86.41 to 87.63 m). Fine bioturbation structures evident initially and from 288 ft (87.78 m) (small scale). Colour mottling tends to be vertically disposed, moderate reddish orange (10R6/6) from 286 ft (87.17 m), weaker below 287 ft (87.48 m) with increasing siltiness. Sphaerosiderite. Tends to crudely colour laminated near base. Passing down into	9	10	3.00	290	8	88.60
Siltstone, clayey, greenish grey (5GY6/1) variably ochreous, red mottled. Very hard, massive. Poorly laminated with very light grey (N8) silt, tinged reddish initially. Some bioturbation. Carbonaceous fragments, tends to medium light grey (N6) (non-mottled), bioturbated below 292 ft (89.00 m), sandy below 293 ft (89.31 m), ochreous mottled within large scale bioturbations. Laminated from 293/4 (89.41 m), variably bioturbated. Very carbonaceous below 294 ft (89.61 m). Many listric surfaces near base. Few pellets of silt to ¼ in (6.4 mm) at base (fairly sharp).	4	8	1.42	295	4	90.02
Mudstone, silty, greenish grey (5GY6/1) to light grey (N7), waxy textured, vaguely laminated. Sphaerosiderite. Many listric surfaces. Homogeneous from 296 ft (90.22 m).	4	8	1.42	300	0	91.44
Sandstone, fine grained, yellowish-grey (5Y8/1), soft, friable. Finely laminated with darker clayey silt. Seen to	1	1	0.33	301	1	91.77
Core lost (in soft sand)	8	6	2.59	309	7	94.36
Siltstone, medium light grey (N6) with darker partings of more clayey material to ¼ in (6.4 mm). Carbonaceous wisps. Bioturbated from 310 ft (94.49 m). Bioturbated base at	0	9	0.23	310	4	94.59
Mudstone, silty, olive grey (5Y4/1), bioturbated. Blebs of very light grey silt to ¼ in (6.4 mm). Carbonaceous fragments, megaspores, fish debris. Sporadic irregular light olive grey (5Y6/1) ironstone pebbles to ¼ in (6.4 mm) from 311/6 to 312/3 (94.95 to 95.17 m). Tends to finely laminated and fissile from 312/8 to 312/10 (95.30 to 95.35 m) with carbonaceous partings and wisps. Bioturbated, dark greenish grey (5G4/1) with light grey (N7) fine sandy pockets below 312/10 (95.35 m). Listric surfaces at base. Sharp base at	3	8	1.12	314	0	95.71
Ironstone, silty, olive grey (5Y4/1) to brownish grey (5YR4/1) faintly mottled, very hard, massive, dense, weathers to brownish grey (5YR4/1) tinged olive	0	5	0.12	314	5	95.83
Mudstone, silty, dark greenish grey (5G4/1) as before with frequent listric surfaces to 315 ft (96.01 m). Rare ironstone nodules to ¼ in (6.4 mm) in top few inches. Traces of fine silt laminae. More massive and silty below 315/3 (96.09 m). Tending to bioturbated with pockets of light grey (N7), medium grained sand. Fish debris. Passing down into	1	1	0.33	315	6	96.16
Siltstone, clayey, medium grey (N5) tinged olive, massive, bioturbated with blebs of fine and medium light grey sand. Sharp base at	0	11	0.28	316	5	96.44
Mudstone, silty, medium grey (N5) tinged olive. Partings of light grey (N7) silt to ⅛ in (3.2 mm). Fissile. Passing down into	0	9	0.23	317	2	96.67
Siltstone, light grey (N7) with dark grey (N3) mudstone partings to ⅛ in (3.2 mm) and light grey fine-grained sand laminae. Fissile. Becomes less well laminated below 317/9 (96.85 m). Some dark greenish grey (5GY4/1) mudstone laminae below 318 ft (96.93 m). Plant debris. Sphaerosiderite. Passing down into	1	4	0.41	318	6	97.08
Mudstone, silty, dark greenish grey (5GY4/1) with fine light grey silt laminae. Fissile. Tends to very silty, medium light grey (N6) tinged olive below 319 ft (97.23 m). A 1 in (25.4 mm) dark greenish grey (5GY4/1) silty mudstone at base with leaves. Sharp base at	1	9	0.53	320	3	97.61
Siltstone, very light grey (N8), fine dark grey mudstone partings to ½ in (12.7 mm). Bioturbation causes pseudo-flame structures at 321/9 (98.07 m). Plant fragments. Pods of ferruginous sand at 322 ft (98.15 m). Passing down into	3	1	0.94	323	4	98.55
Mudstone, silty, medium dark grey (N4) tinged olive with light grey silty laminations and carbonaceous partings to ¼ in (6.4 mm). Sharp base at	0	6	0.15	323	10	98.70
Siltstone, light grey (N7) with dark grey clayey laminations, slightly bioturbated in part, massive. Tends to greenish grey (5GY6/1), bioturbated from 325/3 to 325/6 (99.14 to 99.21 m). Plant fragments near base. Passing down into	1	11	0.59	325	9	99.29
Mudstone, silty, light olive grey (5Y6/1). Striped with silts, variably bioturbated. Worm casts 326/6 (99.5 m). Carbonaceous fragments. Passing down into	1	0	0.30	326	9	99.59

	Thickness ft	in	m	Depth ft	in	m
Siltstone, clayey, light to medium light grey (N6-7). Bioturbated with relict laminations, generally hard, massive. Well laminated, showing local cross-bedding from 327/6 to 328/6 (99.82 to 100.13 m) and from 329/6 to 330/0 (100.43 to 100.58 m) (with rare carbonaceous fragments). Less clayey from 332/0 to 333/6 (101.19 to 101.65 m). Tends to light olive grey (5Y6/1) with fish fragments below 333/6. Sandy from 334/7 (101.98 m). Tends to sandy mudstone at base (not seen). *Euestheria* 333/0 to 335/0 (101.5 to 102.1 m).	8	3	2.52	335	0	102.11
Sandstone, medium grained, yellowish grey (5Y8/1), soft, friable. Tends to clayey at 340/6 (103.78 m). Fragment of very hard siliceous sandstone (loose) (core diameter reduced from 340/8 (103.84 m)). Rapidly passing down into	6	0	1.83	341	0	103.94
Siltstone, light grey (N7), vaguely laminated, slightly bioturbated. Sandy initially in diffuse laminae. Plant and fish fragments. Slightly micaceous. Sharp irregular base at	1	0	0.30	342	0	104.24
Mudstone, silty, medium grey (N5), finely bioturbated, homogeneous. Fine burrows in siltier material. Passing down into	1	0	0.31	343	0	104.55
Siltstone, clayey, light olive grey (5Y6/1) tinged green in spherical and cylindrical zones. Strongly bioturbated, massive. Carbonaceous fragments from 345 ft (105.16 m). Tending to light grey (N7) tinged green from 346 ft (105.46 m). Tending to sandy from 347 ft (105.77 m). Sphaerosiderite at c.347 ft (105.77 m). Passing down into	4	6	1.37	347	6	105.92
Siltstone, sandy, medium light grey (N6), hard, massive, bioturbated. Relict laminations shown by clay wisps and sand partings. Highly carbonaceous (plant fragments), many large fragments at base	3	5	1.04	350	11	106.96
Pellet bed, medium grey (N5), clay matrix with pellets of sand to ½ in (12.7 mm). Carbonaceous fragments. Ferruginous at base. Irregular erosive base at	0	1	0.02	351	0	106.98
Siltstone, sandy, greyish yellow green (5GY7/2) initially, white (N9) from 351/2 (107.04 m). Locally tinged green. Sharp colour change at 355/10 (108.46 m) to greenish grey (5GY6/1), with cylindrical zones to 1½ in (38.1 mm) diameter of ?leached and less clayey material. Green coloration lost below 356/8 (108.71 m). Homogeneous initially, greenish grey (5GY6/1) silty mudstone partings (bioturbated at base) from 351/5 to 351/7 (107.11 to 107.16 m), then with rare greenish silty partings. Sand lost below 352 ft (107.29 m). Large scale bioturbations from 352/5 (107.42 m) with vertical cylindrical zones of coarser sediment to 3 in (0.08 m). Root cavities to 2 in x ⅛ in (0.05 m x 3.2 mm) of green clay material. Tends to laminated from 352/7 (107.47 m). A ½ in (12.7 mm) greenish grey mudstone (5G4/1) at 353/10 (107.85 m). Well laminated, sphaerosideritic to 355 ft (108.20 m). Greenish clayey from 354/2 to 354/9 (107.95 to 108.13 m). Sandy below 355/10 (108.46 m), bioturbated. Tending to laminated from 357 ft (108.81 m). Passing down into	6	2	1.88	357	2	108.86
Siltstone, locally slightly clayey, light olive grey (5Y6/1), hard, massive. Well laminated to 357/5 (108.94 m), with distinct clayey band, medium grey (N5), to ⅛ in (3.2 mm) at 357/3 (108.89 m). Continuing bioturbated with relict lamination to 357/9 (109.04 m) then less bioturbated. Tending to sandy from 358 ft (109.12 m). Carbonaceous fragments. Passing down into	1	4	0.41	358	6	109.27
Siltstone, sandy, light olive grey (5Y6/1). Sand occurs as diffuse partings and blebs within bioturbated matrix. Dark clayey wisps. Clayey towards base. Rare carbonaceous fragments. Sharp burrowed contact at	1	6	0.46	360	0	109.73
Siltstone, light grey (N7) tinged olive, hard massive, homogeneous, bioturbated. Greenish clay wisps. Tending to very sandy at 360/6 (109.88 m) and locally from 361 ft (110.03 m). Sphaerosiderite at 363 ft (110.64 m). Slightly micaceous at 364 ft (110.95 m). Passing down rapidly into	4	3	1.29	364	3	111.02
Siltstone, greenish grey (5GY6/1), hard, massive, bioturbated. Micaceous. Sphaerosiderite. Tends to sandy from 366/2 to 367/6 (111.61 to 112.01 m). Clay lens at 367/6 (112.01 m). Clayey pellets at 370 ft (112.78 m). ?Sharp base at	5	11	1.81	370	2	112.83
Mudstone, silty, greenish grey (5G6/1), massive, homogeneous, bioturbated. Sphaerosiderite. Fairly sharp, bioturbated base at	0	10	0.25	371	0	113.08
Siltstone, very light grey (N8) with greenish grey clayey wisps and pods. Bioturbated. Coarser grained from 371/3 (113.16 m), also increased clay content. Tends to laminated from 372/3 (113.46 m), bioturbated on a small scale. Passing down into	1	6	0.46	372	6	113.54

	Thickness ft	in	m	Depth ft	in	m
Sandstone, fine grained, very light grey (N8), finely laminated with greenish clayey material, patchily bioturbated. Burrows. Sphaerosiderite at 373/9 (113.92 m). Clay galls at 374/8 (114.20 m). Sharp irregular burrowed base at	2	5	0.73	374	11	114.27
Mudstone, very silty, light olive grey (5Y6/1), hard, massive, homogeneous, bioturbated. Passing down into	1	6	0.46	376	5	114.73
Siltstone, light grey (N7) tinged green tending to greenish grey (5GY6/1) from 378 ft (115.21 m). Bioturbated, hard, massive, homogeneous. Rare mudflakes initially (dark greenish grey (5GY4/1)), vaguely laminated with dark greenish grey (5GY4/1) clayey material at 378/10 (115.47 m); burrows, clay galls. Tends to sandy below 379 ft (115.52 m) vaguely laminated from 379/10 to 380/2 (115.77 to 115.87 m). Tending to light grey (N8) from 380 ft (115.82 m), wispy bedded. More clayey from 381/3 (116.20 m) to 381/5 (116.26 m). Very sandy from 381/5 to 381/10 (116.26 to 116.38 m). More clayey from 382/5 to 382/8 (116.56 to 116.64 m). Sharp base in sandy siltstone at	7	5	2.26	383	10	116.99
Mudstone, silty, medium light grey (N6) tinged olive. Burrows at top infilled with coarser sediment. Hard, massive, bioturbated, vaguely laminated. Sharp irregular base	0	9	0.23	384	7	117.22
Siltstone, very light grey (N8), wispy bedded, bioturbated, homogeneous initially with ?rootlets from above. Striped with mudstone (medium light grey (N6)); ½ in (12.7 mm) partings at 385/5 (117.47 m). Carbonaceous partings, locally strong.	1	2	0.36	385	9	117.58
Mudstone, very silty, olive grey (5Y4/1) striped with silt to 386/2 (117.70 m), then bioturbated. Carbonaceous fragments. Burrows. Sharp base at	0	10	0.25	386	7	117.83
Mudstone, silty, greenish grey (5GY6/1) tending to greenish grey (5G6/1), hard, massive, slightly waxy, obviously bioturbated from 390 ft (118.87 m). Plant debris. Sphaerosiderite from 386/10 (117.91 m). Passing down rapidly into	4	5	1.35	391	0	119.18
Siltstone, greenish grey (5G6/1) to very light grey (N8). Rootlets. Clay galls. Passing down into	0	5	0.12	391	5	119.30
Sandstone, silty, light greenish grey (5GY8/1). Passing down into	0	6	0.16	391	11	119.46
Siltstone, greenish grey (5G6/1), massive, bioturbated with relict lamination locally (e.g. 392/9 (119.71 m)). Sandy streaks initially. Tending to sandy from 392/2 to 392/7 (119.53 to 119.66 m). Tending to clayey from 392/7 (119.66 m). A few carbonaceous pellets at 394/7 (120.27 m). Passing down into	2	9	0.83	394	8	120.29
Pellet bed, matrix as above. White silt pellets to ½ in (12.7 mm). Clay wisps and pellets (generally ¼ in (6.4 mm)). Fairly sharp base at	0	2	0.06	394	10	120.35
WADHURST CLAY						
Mudstone, silty, dark greenish grey (5G4/1) mottled dark, yellowish brown (10YR4/2) tending to greyish red mottled (5R4/2) from 404 ft (123.14 m). Many listric surfaces. Variably calcareous. Fish fragments, sparse ostracods and *Chara*. Very silty from 395/1 to 395/5 (120.42 to 120.52 m). Brown mottling increases from 399 ft (121.62 m). Tending to silt laminated, slightly mottled to 403/9 (123.06 m). Increasingly red/brown mottled from 403/9 (123.06 m). Tending to laminated below 405/4 (123.55 m), less mottled noncalcareous, with roots picked out by brown mottling. *Euestheria* at 406/6 (103.90 m). A 1 in (25.4 mm) calcareous siltstone at base.	12	2	3.70	407	0	124.05
Mudstone, silty, greenish grey (5GY6/1), slightly mottled dark yellowish brown (10YR4/2). Calcareous, finely bioturbated. Listric surfaces. Relict laminations at 408/10 (124.61 m). Isolated *Neomiodon* from 407/6 (124.21 m). *Neomiodon* parting at 411/9 (125.50 m). Ostracods throughout	6	0	1.83	413	0	125.88
Mudstone, silty, greenish grey (5GY6/1) initially, rapidly tending to medium light grey (N6). Striped with very light grey (N8) silt. Very slightly calcareous. Ostracods. Laminated, slightly bioturbated initially. Micaceous siltstone at 414/9 (126.42 m). A 1 in (25.4 mm) siltstone at 415/3 (126.57 m) and at 418/6 (127.56 m) (finely laminated, ripple drifted). Further 1 in (25.4 mm) siltstones at 419/2 (127.76 m) and 419/5 (127.84 m), sandy partings at c.418/9 and 420/0 (c.127.63 and 128.02 m). A ¼ in (6.4 mm) *Neomiodon* limestone at 417/9 (127.33 m). Partings of *Neomiodon* at 414/2 (126.24 m), 415/6 (126.64 m), 416/6 (126.95 m), 417/8 (127.30 m). Isolated *Neomiodon* at 415/9 (126.72 m). Winnowed nests of ostracods; partings with ostracods 413/1 (125.91 m) to 418/0 (126.94 m), worm tubes on siltstone at 415 ft (126.49 m). Carbonaceous fragments at c.414/4, 416/0 (c.126.29, 126.80 m). Pod of ironstone at 417/2 to 417/4 (127.15						

	Thickness			Depth		
	ft	*in*	*m*	*ft*	*in*	*m*
to 127.20 m). Bioturbated in part at 418/9 and 419/9 (127.63 and 127.64 m). Fish and ostracod parting at 417/7 (127.28 m).	7	0½	2.15	420	0½	128.03
Pebbly shell bed, quartz pebbles to 1/10 in (2 mm), one ½ in (12.7 mm) chert, shell fragments in clay matrix.	0	0½	0.01	420	1	128.04
Siltstone, sandy, greenish grey (5GY6/1) tending to very light grey (N8) from 420/6 (128.17 m). Bioturbated, rare clayey partings. Carbonaceous fragments. Micaceous parting at 420/2 (128.07 m). Passing down into	2	11	0.89	423	0	128.93
Sandstone, fine grained, white, greenish tinged. Bioturbated initially, tending to very finely laminated with green silt below 424/6 (129.39 m). Sphaerosiderite. Passing down into	2	0	0.61	425	0	129.54
Siltstone, slightly sandy, very light grey (N8), laminated as above. Green clayey silt parting (½ in) (12.7 mm) at 425/8 (129.74 m) (burrowed). Ostracods 425 to 426 ft (129.54 to 129.86 m). Very fine roots to 3 in (0.08 m) in length from 427 ft (130.15 m). Tends to light olive grey from 427 ft (130.15 m), lamination less apparent, locally cross-bedded. Carbonaceous fragments from 431/5 (131.50 m) give wispy bedded appearance. Bioturbated from 431/8 (131.57 m). Lamination preserved in coarser grades from 432 ft (131.67 m), ripple-drift bedded. Tends to clayey from 434 ft (132.28 m), continuing slightly bioturbated, variably laminated. Light grey (N7) below 432 ft (131.67 m). Slightly micaceous at 435/9 (132.82 m). Parting of mud pellets at 437/1 (133.22 m), ferruginous, with ostracods. Sporadic *Euestheria*. Fish fragments at 430/3 (131.14 m) and near base. Passing down rapidly to (contact disturbed)	12	3	3.73	437	3	133.27
Mudstone, very silty, light olive grey (5Y6/1) to medium light grey (N6), tinged green initially. Vaguely laminated, bioturbated. Carbonaceous fragments. Sandy initially, tending to coarse silt laminated from 437/6 (133.35 m). Burrows at 438 ft (133.50 m). Sandy, bioturbated on large scale from 438 ft (133.50 m). Laminated from 438/7 (133.68 m), slightly bioturbated from 439/5 to 439/9 (133.93 to 133.99 m) and from 440 ft (134.11 m), laminations preserved locally. Large scale burrows at 440/6 (134.26 m). Homogeneous weakly laminated from 440/8 (134.42 m). A ¼ in (6.4 mm) ironstone pellet at 441/9 (134.65 m). Less silty, listric surfaces below 441/10 (134.67 m). Coarse sandy lens at 442/9 (134.95 m) with carbonaceous fragments and fish debris. Increasingly sandy, variably laminated from 434 ft (132.28 m) with large scale bioturbation distorting lamination. Incipient ironstone at 442/6 (134.87 m). Parting of greenish grey pellets to 1/25 in (1 mm) at 446/11 (135.00 m). Variable dip of laminations (10° to 30°) evident from 447 ft (136.25 m). Sparse ostracods and *Euestheria* from top to 442 ft (134.72 m). Planty parting at 440/8 (134.32 m). Sharp lignitic base with greenish clay pellets to ½ in (12.7 mm) at base.	10	9	3.28	448	0	136.55
Mudstone, silty, medium grey (N5) tinged greenish; dark greenish grey initially to 448/9 (136.78 m). Striped with silts: thicker partings show bottom structures and slight bioturbation. Many listric surfaces. Dip to 20° *Neomiodon* partings at 448/11 (136.83 m) and 449 ft (136.86 m). Rare ostracods, fish debris. Passing down into	2	0	0.61	450	0	137.16
Siltstone, very light grey, striped with mudstone (as above). Local fine rhythmic structures. Mudstone partings show ?worm tubes. Fish and plant debris, some ostracods. Channelled base at	0	6	0.15	450	6	137.31
Mudstone, silty as above. Siltstones locally calcareous. High siltstone content to 50 per cent. Many minor channel structures, small scale faulting, throws to ¼ in (6.4 mm) at 452/3 (137.85 m), local ripple structures and lenses in silts from 452/6 (137.92 m). Compaction deformation structures locally and at upper contact. Bioturbation in clayey fraction, locally. *Neomiodon* partings at 450/7, 450/9. 450/11, 451/0, 453/0 (137.34, 137.39, 137.44, 137.46, 138.07 m). Local isolated *Neomiodon*, rare ostracods. Dip to 30°.	3	6	1.07	454	0	138.38
Pellet bed, pellets of mudstone, ironstone to ¼ in (6.4 mm) in clayey calcareous (shelly) matrix. ?Non-erosive.	0	1½	0.04	454	1½	138.42
Mudstone, silty as above, finely striped with siltstone. Incipient ironstone formation. Carbonaceous fragments at 455 ft (138.68 m). Rootlets from 455 ft (138.68 m)	1	6½	0.47	455	8	138.89
Mudstone, silty, medium grey (N5) homogeneous. Rootlets at top. Darker grey clay pellets to 1/25 in (1 mm), throughout. Fish fragments, ostracods.	0	11	0.28	456	7	139.17
Mudstone, silty striped. Medium dark grey (N4). Slightly burrowed. *Neomiodon* partings, e.g. 457/10 (139.55 m) on ½ in (12.7 mm) siltstone. Root at 458 ft (139.60 m). Rare poorly preserved ostracods.						

	Thickness			Depth		
	ft	*in*	*m*	*ft*	*in*	*m*
Many listric surfaces initially. Dip c.20°. Sharp base at	2	8	0.81	459	3	139.98
Mudstone, silty, dark greenish grey (5GY4/1), calcareous. Relict silty partings. Shell and fish fragments, ostracods and *Euestheria*. Listric surfaces. A ½ in (12.7 mm) siltstone with rootlets at base.	1	3	0.38	460	6	140.36
Mudstone, silty, greenish initially, tending to medium dark grey (N4), striped with siltstone showing bottom structures. Rootlets initially. Lenses of limestone at 461/2, 461/4, (to 1 in) (140.56, 140.61 m, (to 25.4 mm)). A 1 in (25.4 mm) ironstone nodule at 461/6 (140.67 m). A 1in (25.4 mm) siltstone at 462/7 (141.00 m). Incipient ironstone at 463 ft (141.12 m). Listric surfaces. Dip c.15°. Ostracods locally abundant, often with ferruginous coating	2	9	0.83	463	3	141.20
Mudstone, silty, dark greenish grey (5G4/1), calcareous. *Chara*, ostracods. Many listric surfaces.	1	5	0.43	464	8	141.63
Mudstone, silty striped, colour as above, calcareous, ostracods.	1	2	0.36	465	10	141.99
Mudstone, silty striped, dark greenish grey (5GY4/1), noncalcareous. Local channel structures in silts. Tends to medium grey (N5) at 467 ft (142.34 m). A ½ in (12.7 mm) siltstone at 468 ft (142.64 m). Incipient ironstone. Roots at 467/0 to 467/6 (142.34 to 142.49 m), silt filled. Fragmentary ostracods and fish debris. Many listric surfaces. Sheared on a small scale. Dip from 0° to 30°	2	5	0.73	468	3	142.72
Mudstone, silty, greenish grey (5GY4/1), calcareous. Ironstone fragments at c.469 ft (142.95 m). Silty striped from c.472/6 (c.144.02 m). Carbonaceous fragments. Rare ostracods, small gastropods, fish and plant debris. Many listric surfaces. Core part reconstituted. ?Sheared zone of grey silty mudstone to 2 in at 471/4 (0.05 m at 143.66 m) and below.	6	9	2.06	475	0	144.78
FAULT ZONE (Wadhurst Clay)						
Shear zone. Main lithology is medium dark grey (N4) mudstone striped with silt. Greenish grey clay pellets at top. Siltstone fragments to ½ in (12.7 mm). Ironstone pebbles to ¼ in (6.4 mm).	0	6	0.15	475	6–10	144.93 –145.03
ASHDOWN BEDS						
Foot wall 1 in (25.4 mm) zone; inclined at 60°, of sheared siltstone with mudstone partings; an overlying upper coarse sandy zone.	0	1	0.03	475	7–11	144.96 –145.06
Siltstone, light olive grey (5Y6/1), variably laminated. Slightly bioturbated, hard, massive. Ferruginous silt bands near the base. Micro-faulting. *Euestheria*. Few listric surfaces. Passing down into	1	5	0.43	477	0	145.39
Mudstone, very silty, light grey (N7), hard, massive, striped with silt to 1 in (25.4 mm). Few burrows. Increasingly silty, bioturbated from 478 ft (145.69 m). Bioturbation lost below 479/11 (146.28 m). Continuing well laminated, with coarse silt channel fills. Micro-faulting (normal low angle) with throws to ½ in (12.7 mm). Distorted mudcracks. Tending to bioturbated from 481/3 to 481/5 (146.68 to 146.74 m). Wispy bedded from 481/5 (146.74 m), with mudcracks in fine grade and micro-faulting. *Euestheria*. Passing down into	5	11	1.80	482	11	147.19
Siltstone, light olive grey (5Y6/1), generally well laminated. Sandy partings. Distorted mudcracks near base. Passing down into	0	8	0.21	483	7	147.40
Pellet bed: pellets of ironstone to ½ in (12.7 mm), smaller pellets of mudstone, few quartz pebbles in matrix as above siltstone.	0	1	0.02	483	8	147.42
Siltstone, light olive grey (5Y6/1), generally hard, massive, well laminated with clayey material. Cross-bedded on a fine scale initially. Carbonaceous wisps and partings. Locally part bioturbated below 484 ft (147.52 m); burrows and distorted mudcracks. Increased bioturbation with relict laminations below 485/1 (147.85 m). Very clayey from 485/6 (147.98 m). Tending to laminated from 486/3 (148.21 m) to 486/7 (148.31 m), continuing finely bioturbated (?worms). Large plant fragments at 487/5 (148.56 m). Less clayey from 488 ft (148.74 m). A 7 in (0.18 m) root from 489/3 (149.12 m) penetrates contact below. Sharp base at	5	10	1.78	489	6	149.20
Siltstone, light grey (N7) tinged green mottled, bioturbated initially, with plant tubes; sphaerosiderite. Tends to be laminated from 491/6 (149.81 m) (greenish silty striped in sandy silt), locally cross-laminated. Laminated medium grey (N5) from 492 ft (149.96 m) slightly bioturbated locally. Ostracods from c.494/0 to 495/0 (150.6 to 150.9 m). A ½ in (12.7 mm) pyrite streak at 494/7 (150.75 m). Light olive grey (5Y6/1) from 496 ft (151.18 m). Clayey from 497/8 to 497/10 (151.69 to 151.74 m). Bioturbated from 497/10 (151.74 m). Ironstone blebs and disseminated pellets from 499 ft (152.10 m). Carbonaceous fragments in non-green lithology. Passing down into	10	3	3.12	499	9	152.32

	Thickness			Depth		
	ft	in	m	ft	in	m
Mudstone, very silty, light olive grey (5Y6/1), hard, massive, bioturbated. Tends to greenish grey (5GY6/1) from 500/6 (152.55 m), with silt infilled ?mudcracks. Tends to light olive grey (5Y6/1) from 501/2 (152.76 m). Listric surfaces. Carbonaceous fragments. Sharp base at	2	5	0.74	502	2	153.06
Siltstone, sandy, very light grey (N8) tinged yellow, generally hard, massive, bioturbated. Tends to be laminated from 502/9 (153.24 m), slightly bioturbated. Fish fragments. Carbonaceous wisps and partings from 502/8 (153.21 m). Passing down into	1	4	0.41	503	6	153.47
Siltstone, very clayey, light olive grey (5Y6/1), hard, massive, bioturbated, with relict laminations. Carbonaceous fragments. Passing down into	0	10	0.25	504	4	153.72
Mudstone, very silty, medium grey (N5) tinged olive, hard, massive; bioturbated with local relict laminations. Passing down into	0	6	0.15	504	10	153.87
Siltstone, light olive grey (5Y6/1), hard, massive, bioturbated. Sandy locally. Carbonaceous fragments. Passing down into	0	9	0.23	505	7	154.10
Mudstone, very silty, greenish grey (5GY6/1). Sphaerosiderite. Passing down into	0	4	0.10	505	11	154.20
Siltstone, very light grey (N8) mottled greenish, hard, massive, bioturbated, with local relict laminations. Sphaerosiderite. ?Sharp bioturbated base at	1	3	0.38	507	2	154.58
Mudstone, very silty, olive grey (5Y4/1), striped with silt on a large scale, generally bioturbated. Plant fragments. Passing down into	1	8	0.51	508	10	155.09
Siltstone, very light grey (N8), hard, massive, bioturbated. Increasingly clayey to base, giving greenish mottled structure. Pellets of ironstone to ½ in (12.7 mm) and siltstone to 1/10 in (2 mm). Sharp base at	0	7	0.18	509	5	155.27
Siltstone, very light grey (N8), mottled light olive grey (5Y6/1), hard, massive, bioturbated, with rare relict laminations from 511 ft (155.75 m). Rare carbonaceous fragments. Less hard from 511 ft (155.75 m). Finely laminated at 511/6 (155.91 m) and from 512/8 to 513/8 (156.26 to 156.57 m); increasingly laminated from 513/8 (156.57 m) with channel structures, mudcracks infilled with silt, micro-faulting. Generally bioturbated below 515 ft (156.97 m) with local, commonly deformed, relict laminations. Rootlets at 509/8 (155.35 m). Sharp ?slumped contact at base.	6	7	2.01	516	0	157.28
Sandstone, silty, very light grey (N8), vaguely laminated with darker silt, carbonaceous wisps and partings. Passing down into	0	10	0.25	516	10	157.53
Siltstone, very light grey (N8), vaguely laminated with darker silt tending to bioturbated from 517/9 (157.81 m). Rapidly passing down into	1	5	0.43	518	3	157.96
Mudstone, silty, light olive grey (5Y6/1), hard, massive, bioturbated. Large silt infilled deformed burrows. Tending to be siltier from 519 ft (158.19 m). Listric surfaces. Passing down into	1	1	0.33	519	4	158.29
Siltstone, very light grey (N8), hard, massive, bioturbated. Sphaerosiderite near base. A 1 in dark greenish grey (5GY4/1) clayey streak at base.	0	8	0.21	520	0	158.50
Sandstone, silty, very light grey (N8) tending to pale olive (10Y6/2) at 520/2 (158.56 m) with greenish silt laminations. ?Rootlets at top. Sphaerosiderite. Passing down into	1	0	0.30	521	0	158.80
Siltstone, very light grey (N8) mottled light green. Bioturbated with relict lamination, and burrows initially. Tending to be well laminated from 521/10 (159.05 m). Local breaks in laminae caused by ?sediment compaction. Passing down into	1	3	0.38	522	3	159.18
Mudstone, silty, medium grey (N8) tinged olive. Finely laminated with silt tending to massive, homogeneous. Large silt-filled ?deformed mudcracks near base. Passing down into	1	9	0.54	524	0	159.72
Siltstone, clayey, very light grey (N8) mottled darker (olive) green, bioturbated. Tends to sandy with greenish clayey galls to base. Sharp base at	1	1	0.33	525	1	160.05
Sandstone, silty, very light grey (N8) mottled dark greenish grey (5GY4/1) (in silt grade), extensively ?burrowed. Relict laminations below 526/6 (160.48 m). Generally homogeneous from 527 ft (160.63 m). Finely silt laminated from 528 ft (160.93 m); ripple-drift bedding, local channel-like features due to ?burrowers from 529 ft (161.24 m). Carbonaceous fragments, streaks and partings from 528 ft (160.93 m). Bituminous streak at 529/9 (161.47 m). Passing down into	5	2	1.57	530	3	161.62
Siltstone, slightly sandy, very light grey (N8), wispy bedded with darker silt, slightly bioturbated. Sharp base at	1	10	0.56	532	1	162.18

	Thickness			Depth		
	ft	*in*	*m*	*ft*	*in*	*m*
Mudstone, silty, olive grey (5Y4/1), homogeneous. Listric surfaces. Fairly sharp, bioturbated base at	0	5	0.13	532	6	162.31
Siltstone, variably sandy, very light grey (N8) tending to light olive grey (5Y6/1), mottled greenish grey. Prominent greenish streak at 533/6 (162.61 m). Mottled light medium grey (N6) from 534 ft (162.76 m). Bioturbated, homogeneous. Locally laminated at 534/6 (162.92 m), tending to clayey. Well laminated from 535/6 to 536/0 (163.22 to 163.37 m). Tending to be laminated from 537/5 to 537/8 (163.80 to 163.88 m). ?Burrows with carbonaceous linings at 538 ft (163.98 m). Continuing finely bioturbated with relict lamination to 539/6 (164.44 m). Striped in darker silt, part bioturbated from 539/6 (164.44 m); former ripple structures evident. Local carbonaceous wisps and partings. Passing down into	7	10	1.38	540	4	164.69
Siltstone, clayey, mottled light grey (N7) (tending to olive) and white. Hard, massive, bioturbated, with local relict striping. Tending to be laminated from 540/7 (164.77 m). Few carbonaceous fragments.	0	10	0.26	541	2	164.95
Pellet bed. Pellets of silt to ⅛ in (3.2 mm). In greenish clayey matrix. Carbonaceous wisps. Sphaerosiderite. Irregular shape, aggregate thickness ½ in (12.7 mm)	0	0½	0.01	541	2½	164.96
Mudstone, very silty, mottled greyish blue (5PB5/2) and light olive grey (5Y6/1), hard, massive, wispy bedded. Greenish mottled with pellets of silt to ⅛ in (3.2 mm) at base. Sharp inclined base at	0	4½	0.11	541	7	165.07
Siltstone, clayey, colour as above mudstone, hard, massive, bioturbated with rare relict lamination. Sphaerosiderite in blebs. Relict ochreous roots. Transitional base.	1	2	0.36	542	9	165.43
Mudstone, silty, light olive grey (5Y6/1), hard, massive, bioturbated. Bluish trace fossils. Becomes siltier from 544/3 (165.89 m). Tending to olive grey (5Y4/1) (greenish). Listric surfaces. Sphaerosiderite. Sharp, bioturbated base at	2	11	0.89	545	8	166.32
Siltstone, very light grey (N8), hard, massive, bioturbated (burrowed), seen to base at	0	4	0.10	546	0	166.42

Appendix 2: The Sequence of Ostracod Faunas in the Wadhurst Clay of the Cooden Borehole

By F. W. Anderson, DSc, FRSE

INTRODUCTION

This borehole penetrated the lower part of the Weald Clay, the Tunbridge Wells Sand, Wadhurst Clay and the upper part of the Ashdown Beds (Fig. 3). Valuable evidence was obtained for the interpretation of the ostracod faunas, particularly from the Wadhurst Clay. To prepare an account of the ostracod distribution samples were washed at 1 ft (0.3 m) intervals and sieved through a 100 mesh sieve. Consequently as well as the ostracods whose distribution is shown on Fig. 4, data was also collected on the amount of coarse sediment, sphaerosiderite and other characters. The interpretation of these records amplifies the lithology as seen in the cores and also illustrates the difficulties of lithological definition of the boundaries of the Weald Clay, Tunbridge Wells Sand and Wadhurst Clay.

WEALD CLAY

The lower part of the Weald Clay is composed largely of siltstones and silty mudstones and no ostracods were recovered. Plant remains were found at many levels and there was a sporadic distribution of fish debris.

The base of the Weald Clay is taken by R. D. Lake at 44 ft 5 in (13.54 m), where a sharp contact occurs at the base of a silty mudstone. The author would prefer to place this junction at 96 ft 9 in (24.49 m) at the top of the highest dominantly sandy sequence attributed to the Upper Tunbridge Wells Sand. It is thought that the sediments missing between this level and 113 ft 6 in (34.59 m) were soft sandstone (see log). The sequence would then be comparable with that at Warninglid (Lake and Thurrell, 1974), which is the only locality where evidence for the incoming of the Weald Clay ostracod fauna is recorded.

TUNBRIDGE WELLS SAND

The Tunbridge Wells Sand contains interbedded sandstones, sandy siltstones and mudstones. Sphaerosiderite is abundant, particularly between 130 and 135 ft (39.62 and 41.15 m). Most beds contain plant debris. Fish remains occur in the mudstones between 150 and 155 ft (45.72 and 47.24 m). The occurrence of ostracods indicating an age equivalence to the Lower Grinstead Clay of the Horsham area leads the author to suggest that the chronostratigraphic equivalents of the lithological units of the Tunbridge Wells Sand of that area are to be found between the depths listed below. This does not necessarily imply that these lithological units are continuous between Cooden and Horsham.

In this part of the borehole the only ostracods recovered were from the unit equated with the Lower Grinstead Clay facies, and these were rare and poorly preserved. In a sample from 254 to 255 ft (77.42 to 77.72 m) a single specimen of *Theriosynoecum alleni* (Pinto and Sanquinetti) was found which may indicate the position of the Grinstead Cycle S-phase. In addition a specimen of *Cytheridea aculeata aculeata* Jones was recovered from a sample at 264 to 265 ft (80.47 to 80.77 m), suggesting a horizon in the Grinstead Clay and probably in the lower part of this unit. The presence of ostracods, in itself, is an indication of an age equivalent to the Grinstead Clay, as they are very rare elsewhere in the Tunbridge Wells Sand except for its very highest beds at Warninglid.

The Lower Tunbridge Wells Sand consists of siltstones and fine sandstones, frequently containing sphaerosiderite. It contains much plant debris, *Euestheria* was found between 325 and 335 ft (99.4 and 102.1 m) but fish remains are not common. The base is taken by Lake at a pellet bed at 394 ft 10 in (120.35 m) but may be a little higher at c.391 ft (119.2 m) (see below).

WADHURST CLAY

In this account the term Wadhurst Clay is used to contain the beds considered to be the time equivalents of the faunicycles defined in it at Wadhurst Park (Anderson in Anderson and others, 1967), that is, the Rye to Fletching Cycles inclusive. Where a fauna is

	ft in	*m*
Upper Tunbridge Wells Sand	96 7 to 146 8	24.44 to 44.70
Upper Grinstead Clay	to 205 6	to 62.64
Sandstone equivalent to the Cuckfield Stone of Horsham	to 235 8	to 71.83
Lower Grinstead Clay	to 265 2	to 80.82
Lower Tunbridge Wells Sand	to c.391?	to 119.2

absent or was not recovered, for example, due to lithological variation within a continuous sequence, its thickness can be estimated from other boreholes.

In contrast to the overlying beds much of the Wadhurst Clay contains abundant and characteristic ostracods and a series of faunas can be established. These are shown in Fig. 4.

The faunas contain species of the genus *Cypridea*, whose ranges and abundance are shown in Fig. 4 (C-phase species), and also a group of genera and species referred to as S-phase species. These latter include *Cytheridea (Haplocytheridea) delicatula* Martin, *Damonella pygmaea* (Anderson), *Darwinula jonesi* Anderson, *D. leguminella* (Forbes), *D. oblinga* (Roemer), *Mantelliana phillipsiana* (Jones), *Theriosynoecum alleni* and *Rhinocypris jurassica* (Martin). The combination of the ranges of S-phase and C-phase ostracods has been interpreted to show a series of faunicycles, the evidence for these is considered in detail by Anderson (in Anderson and others, 1967). The Tillsden Cycle of the *C. aculeata* Zone is not now recognised as a distinct unit. The C-phase fauna of this cycle is now regarded as being the upper part of a rather expanded Crowhurst Cycle. The abundance of S-phase species as a percentage is shown on the right of Fig. 4, together with their ranges.

The faunas can also be divided between two zones. The lower, the Zone of *Cypridea paulsgrovensis*, in which this species is common and often dominant in the fauna, and an upper, the Zone of *Cypridea aculeata*, in which that species, together with *C. melvillei* Anderson and *C. recta* Wolburg are predominant. In what are regarded as the more saline phases *Theriosynoecum alleni* is more abundant in the lower zone and *Rhinocypris jurassica* in the upper.

The following faunicycles can be established for the Wadhurst Clay.

Fletching Cycle

The Fletching Cycle is estimated to be 8 to 10 ft (2.44 to 3.05 m) thick. The Fletching S-phase was not identified at Cooden but was probably located at about 399 ft (121.6 m), as darwinulids and *Cytheridea delicatula* were found just below this level. No C-phase fauna was found. The sediments are mainly siltstones containing some fish and plant debris and only a few ostracods. Comparison with the Wadhurst Park boreholes suggests that this cycle should represent about 8 ft (2.44 m) of strata at Cooden. If this is so then the base of the Lower Tunbridge Wells Sand could be at about 391 ft (119.17 m) and not at 394 ft 10 in (120.35 m).

Hawkhurst Cycle

The Hawkhurst Cycle is about 12 ft (3.66 m) thick, with sediments which are mainly red-green mottled siltstones, a lithology characteristic of this cycle. Plant remains other than *Chara* gyrogonites are absent except at the top of the cycle where they are associated with *Euestheria*. Fish debris is scarce; a shell fragment layer was found at 407 to 408 ft (124.05 to 124.35 m). Ostracods are fairly common.

The S-phase fauna was found throughout most of the sequence in varying proportions and includes *Cytheridea delicatula, Damonella pygmaea, M. phillipsiana, R. jurassica* and darwinulids.

In the C-phase, species allied to *C. aculeata* make up 34 per cent of the fauna and include *C. aculeata, C. frithwaldi, C. lasius* and *C. pendae*. The remainder of the fauna includes numerous *C. melvillei* also *C. asseri, C. bispinosa, C. recta* (mainly the subspecies *tillsdenensis*) and *C. laevigata*. A few specimens of *C.* giffordi? are present and also some resembling *C. arenosa* occur at the top of the cycle. At Wadhurst Park (Anderson and others, 1967) this species does not range up above the Wadhurst Cycle. However it does not

Cypridea aculeata Zone (lower part only)

		Depth ft	*Depth m*
Fletching Cycle	(few ostracods)	c.391 to 399	c.119.17 to 121.61
Hawkhurst Cycle	C & S-phases	399 to 411	121.61 to 125.27
Crowhurst Cycle	C & S-phases	411 to 426	125.27 to 129.84
Wadhurst Cycle	S-phase only	426 to 438	129.84 to 135.50
Lindfield Cycle	C-phase only	438 to 449	135.5 to 136.86

Cypridea paulsgrovensis Zone (upper part only)

		Depth ft	*Depth m*
Fairlight Cycle	C & S-phases	449 to 465	136.86 to 141.73
St Leonards Cycle	C & S-phases	465 to 476	141.73 to 145.08

FAULT

reach the abundance at Cooden which it has at Wadhurst in the Lindfield Cycle. A large inverse species resembling *C. valdensis* (J. de C. Sowerby) is a new record.

Crowhurst Cycle

The Crowhurst Cycle, which is 15 ft (4.54 m) thick, includes the Tillsden Cycle of Wadhurst Park (Anderson in Anderson and others, 1967).

The upper 9 ft (2.74 m) of the cycle consists mainly of mudstones and the part below 420 ft 0½ in (128.03 m), of sandy siltstones and sandstones which continue upwards from the underlying cycle. Plant remains are abundant. Some fish debris occurs and shell fragments are present in the mudstones which also contain ostracods. The base of the cycle was taken at an S-phase fauna, consisting largely of *M. phillipsiana,* found within a coarse grey siltstone at 425 to 426 ft (129.54 to 129.85 m). A variety of S-phase forms also occur in the mudstones at the top of the cycle but no ostracods were found in the 6 ft (1.82 m) of intervening sandstones. The mudstones also contain a C-phase fauna dominated by *C. recta* (mainly *C. recta tillsdenensis*), to which 52 per cent of the specimens belonged. *C. aculeata* and the allied species, *C. arenosa, C. frithwaldi, C. pendae* and *C. vericae,* amount for a further 32 per cent. Other species present include *C. bispinosa, C. giffordi,* C. laevigata and *C. melvillei.*

Wadhurst Cycle

The cycle, which is 12 ft (3.66 m) thick, is composed largely of fine sandstones and siltstones and no C-phase ostracods were found, possibly due to leaching of the shells. Plant and fish debris occur and also *Euestheria* and megaspores. The poorly preserved S-phase ostracods found at 437 to 438 ft (133.2 to 133.5 m) include *Darwinula leguminella* and *M. phillipsiana* and are assigned to the basal S-phase of the cycle.

Lindfield Cycle

The sediments of the Lindfield Cycle (11 ft (3.36 m) thick) are mainly siltstones with a coarser sandstone bed about 4 ft (1.2 m) above the base of the cycle. Plant debris is abundant but fish debris is scarce; fragments of shell occur between 439 and 440 ft (133.8 and 134.11 m). The S-phase fauna contains *Damonella pygmaea,* darwinulids and *M. phillipsiana* both high and low in the cycle. The C-phase fauna is scarce and rather poorly preserved. *C. aculeata antiqua* Anderson is the commonest taxon but some specimens approach the form of *C. tuberculata* and *C. asseri?* and *C. laevigata* also occur. The base of the cycle also contains the highest record of *C. paulsgrovensis,* an ostracod which is characteristically abundant in the cycles below. *C. arenosa,* usually a dominant form at this level, was not found.

Fairlight Cycle

The sediments of the Fairlight Cycle (16 ft (4.87 m) thick) are mainly mudstones with some siltstones; abundant worm casts, some plant and fish debris and also *Chara* gyrogonites occur. The beds are shelly at several horizons and some *Euestheria* were found.

The S-phase is dominated by *R. jurassica* although a variety of ostracods of this phase are abundant, particularly near the base of the cycle. The C-phase shows a dominance of *C. paulsgrovensis* which, together with a small representative of *C. menevensis,* forms 68 per cent of the fauna. Species allied to *C.* aculeata, mainly *C. aculeata antiqua,* but also including some *C. frithwaldi, C. lasius, C. pendae* and *C. tuberculata,* constitute another group of forms. *C.* bispinosa, *C. melvillei* and *C. recta* are also present.

St Leonards Cycle

The sediments of the St Leonards Cycle (11 ft (3.35 m) thick) are mainly pyritous mudstones with worm casts, *Chara* gyrogonites, plant and fish debris. Shell fragments occur near the base of the cycle and ostracods are relatively scarce.

T. alleni is the characteristic form of the S-phase and with it occurs a variety of other species. The C-phase is dominated again by *C. paulsgrovensis* (46 per cent), accompanied by *C. melvillei* (25 per cent), *C. laevigata* (23 per cent), *C. aculeata antiqua, C. bispinosa* and *C. pendae. C. laevigata* is usually more abundant at this horizon than elsewhere in the Wadhurst Clay; the absence of *C. tuberculata,* which is a distinctive member of the fauna at Wadhurst Park, is interesting.

The St Leonards Cycle is faulted against the Ashdown Beds so that the lower cycles of the Wadhurst Clay are missing.

ASHDOWN BEDS

Below the fault the siltstones and sandstones contain *Equisetites* rootlets and some fish debris. A few ostracods, preserved in iron oxide, were recovered from between 494 and 495 ft (150.57 and 150.88 m) and are referred to *Mantelliana phillipsiana.* This occurrence may represent one of the S-phases of the Ashdown Beds. The highest of these is some 200 ft (61 m) below the base of the Rye Cycle of the Wadhurst Clay. This would suggest a throw on this fault of 182 ft (55.5 m). Correlation with the next lower S-phase would indicate a throw of the order of 282 ft (85.9 m).

CONCLUSION

In the Wadhurst Clay between the Horsham area, Wadhurst Park and Cooden there is considerable lithological variation. Near Horsham the beds consist of alternating siltstones and mudstones mottled red and green in the upper part and ferruginous below. At Wadhurst Park a few feet of sandstone divides the upper mottled sediments from the lower ferruginous beds. In the Hastings area this sandstone is much thicker and there is virtually no trace of an ostracod fauna throughout its thickness of 17 ft (5.18 m) (see Fig. 4). However, despite this, it is practicable to recognise the sequence of faunicycles over this area, though fossils other than ostracods are, at present, of little help for correlation. The remaining fauna of bivalves and small gastropods are usually fragmentary. Fish debris is fairly common, consisting of teeth, small vertebrae and bone

fragments; scales and coprolites are much less common, especially in the upper part of the Wadhurst Clay. At Cooden the abundance of sphaerosiderite is notable and may be correlated with the high carbonaceous content of the sediments.

References

ALLEN, P. 1941. A Wealden soil bed with *Equisetites lyelli* (Mantell). *Proc. Geol. Ass.*, Vol. 52, pp. 362–374.

—— 1959. The Wealden Environment: Anglo-Paris Basin. *Phil. Trans. R. Soc.* (B), Vol. 242, pp. 283–346.

—— 1960. Geology of the central Weald: a study of the Hastings Beds. *Geol. Ass. Centenary Guide*, No. 24.

ANDERSON, F. W., BAZLEY, R. A. and SHEPHARD-THORN, E. R. 1967. The sedimentary and faunal sequence of the Wadhurst Clay (Wealden) in boreholes at Wadhurst Park, Sussex. *Bull. Geol. Surv. G. B.*, No. 27, pp. 171–235 .

BRISTOW, C. R. and BAZLEY, R. A. 1972. Geology of the country around Royal Tunbridge Wells. *Mem. Geol. Surv. G. B.*

GALLOIS, R. W. 1965. The Wealden District. *Br. Reg. Geol., Inst. Geol. Sci.*

LAKE, R. D. 1968. P. 78 in *Annu. Rep. Inst. Geol. Sci. for 1967.*

—— and THURRELL, R. G. 1974. The sedimentary sequence of the Wealden Beds in boreholes near Cuckfield, Sussex. *Rep. Inst. Geol. Sci.*, No. 74/2.

LEES, G. M. and COX, P. T. 1937. The geological basis of the present search for oil in Great Britain. *Q. J. Geol. Soc. London*, Vol. 93, pp. 156–194.

MANTELL, G. A. 1833. *The Geology of the South-East of England.* (London).

REEVES, J. W. 1949. Surface problems in the search for oil in Sussex. *Proc. Geol. Ass.*, Vol. 59 for 1948, pp. 234–269.

SHELTON, J. W. 1967. Stratigraphic models and general criteria for recognition of alluvial, barrier-bar, and turbidity current sand deposits. *Am. Ass. Petrol. Geol. Bull.*, Vol. 51, pp. 2441–261.

TAITT, A. H. and KENT, P. E. 1958. Deep boreholes at Portsdown (Hampshire) and Henfield (Sussex). *Techn. Publ. BP Co. Ltd* (London: BP Co. Ltd).

WHITE, H. J. O. 1928. The geology of the country near Hastings and Dungeness. *Mem. Geol. Surv. G. B.*

WILLIAMS, P. F. 1968. The sedimentation of Westphalian (Ammanian) Measures in the Little Haven-Amroth Coalfield, Pembrokeshire. *J. Sed. Petrolog.*, Vol. 38, pp. 332–362.

WORSSAM, B. C. and IVIMEY-COOK, H. C. 1971. The stratigraphy of the Geological Survey Borehole at Warlingham, Surrey. *Bull. Geol. Surv. G. B.*, No. 36, pp. 1–178.

Phototypeset by the Institute of Geological Sciences.
Printed in England for Her Majesty's Stationery Office
by Unwin Brothers Limited, The Gresham Press,
Old Woking, Surrey

Recent Reports of the Institute of Geological Sciences

No. 73/1 The sand and gravel resources of the country around Maldon, Essex: Description of 1 : 25 000 resource sheet TL 80. By J. D. Ambrose. Price £1.20.

No. 73/2 Geological investigations with a manned submersible in the Irish Sea and off western Scotland 1971. By R. A. Eden, C. E. Deegan, G. H. Rhys, J. E. Wright and M. R. Dobson. Price 50p.

No. 73/3 Ordovician ash-flow tuffs in eastern Snowdonia. By M. F. Howells, B. E. Leveridge and C. D. R. Evans. Price 55p.

No. 73/4 The sand and gravel resources of the country around Hethersett, Norfolk: Description of 1 : 25 000 resource sheet TG 10. By E. F. P. Nickless. Price £1.60.

No. 73/5 The sand and gravel resources of the country around Terling, Essex: Description of 1 : 25 000 resource sheet TL 71. By C. H. Eaton. Price £1.20.

No. 73/6 Computer mapping of drift lithologies from borehole records. By D. W. Rhind. Price 45p.

No. 73/7 The mode of intrusion of Cornish elvans. By A. J. J. Goode. Price 30p.

No. 73/8 The sand and gravel resources of the country around Layer Breton and Tolleshunt D'Arcy, Essex: Description of 1 : 25 000 resource sheet TL 91 and part of TL 90. By J. D. Ambrose. Price £1.30.

No. 73/9 The superficial deposits of the Firth of Clyde and its sea lochs. By C. E. Deegan, R. Kirby, I. Rae and R. Floyd. Price 95p.

No. 73/10 The petrology of volcanic rocks from the Small Isles of Inverness-shire. By W. I. Ridley. Price 80p.

No. 73/11 The geology of the south Irish Sea. By M. R. Dobson, W. E. Evans and R. Whittington. Price 75p.

No. 73/12 The geology of Peterborough. By A. Horton, R. D. Lake, G. Bisson and B. C. Coppack. Price £2.25.

No. 73/13 The sand and gravel resources of the country around Shotley and Felixstowe, Suffolk: Description of 1 : 25 000 resource sheet TM 23. By R. Allender and S. E. Hollyer. Price £1.60.

No. 73/14 The geology of the Sea of the Hebrides. By P. E. Binns, R. McQuillin and N. Kenolty. Price £1.20.

No. 73/15 The sand and gravel resources of the country around Attlebridge, Norfolk: Description of 1 : 25 000 resource sheet TG 11. By E. F. P. Nickless. Price £1.85.

No. 73/16 Deposits of gypsum at Hurworth Place, Darlington. By D. B. Smith and P. J. Moore. Price 20p.

No. 73/17 A new look at river capture and at the denudation history of the Weald. By B. C. Worssam. Price 30p.

No. 73/18 A computer system for storage and retrieval of hydrogeological data from well records. By Betty I. Harvey. Price 50p.

No. 74/1 Analysis of geological data using Rokdoc, a Fortran IV package for the IBM 360/65 computer. By T. V. Loudon. Price £1.40.

No. 74/2 The sedimentary sequence of the Wealden beds in boreholes near Cuckfield, Sussex. By R. D. Lake and R. G. Thurrell. Price 75p.

No. 74/3 The Black Ven landslip, Charmouth, Dorset. An example of the effect of a secondary reservoir of groundwater in an unstable area. By B. W. Conway. Price 65p.

No. 74/4 Basal Purbeck evaporites of the Fairlight Borehole, Sussex. By D. W. Holliday and E. R. Shephard-Thorn. Price 40p.

No. 74/5 The Gaborone Granite, Kanye Volcanics and Ventersdorp Plantation Porphyry, Botswana; geochronology and review. By R. R. Harding, R. N. Crockett and N. J. Snelling. Price 50p.

No. 74/6 The sand and gravel resources of the country west of Colchester, Essex: Description of 1 : 25 000 resource sheet TL 92. By J. D. Ambrose. Price £1.45.

No. 74/7 IGS Boreholes 1973. Price 55p.

No. 74/8 A proposed standard lithostratigraphic nomenclature for the southern North Sea and an outline structural nomenclature for the whole of the (UK) North Sea. Compiled by G. H. Rhys. Price £1.45.

No. 74/9 The sand and gravel resources of the country around Tattingstone, Suffolk: Description of 1 : 25 000 resource sheet TM 13. By S. E. Hollyer. Price £1.95.

No. 74/10 Infiltration studies on the Lower Greensand outcrop near Liss, Hampshire. By R. Kitching. Price 45p.

No. 74/11 The sequence of Pleistocene deposits proved during the construction of the Birmingham motorways. By A. Horton. Price 40p.

No. 74/12 Preliminary report on seismic reflection surveys in sea areas around Scotland, 1969-1973. By R. McQuillin and M. Bacon. Price 35p.

No. 74/13 Classification of the Carboniferous rocks of South-west England. By E. A. Edmonds. Price 40p

No. 74/14 The sand and gravel resources of the country around Gerrards Cross, Buckinghamshire: Description of 1 : 25 000 resource sheets SU 98, SU 99, TQ 08 and TQ 09. By H. C. Squirrell. Price £2.20.

No. 74/15 Gravity survey of Malawi. By E. M. Andrew. Price £2.60.

No. 74/16 The geology of the new town of Milton Keynes: Explanation of 1 : 25 000 Special Geological Sheet SP 83 with parts of SP 73, 74, 84, 93 and 94. By A. Horton, E. R. Shephard-Thorn and R. G. Thurrell. Price £1.45.

No. 75/1 Expeditions to Rockall 1971-72. Edited by R. K. Harrison. Price £1.05.

No. 75/2 A mathematical model of the Akrotiri Plio-Pleistocene gravel aquifer, Cyprus. By R. Kitching. Price 55p.

No. 75/3 Feasibility studies for a petrographical data bank. By E. M. Gill. Price 60p.

No. 75/4 The engineering geology of the Pleistocene deposits of the Birmingham district. By A. Horton. Price 35p.

No. 75/5 A system for the computer storage and retrieval of petrographical and related data. By R. I. Lawson, J. R. Hawkes and J. Dangerfield. Price 80p.

No. 75/6 Geochemical survey of stream waters and stream sediments from the Cheviot area. By H. W. Haslam. Price 50p.

No. 75/7 IGS Boreholes 1974.*

No. 75/8 Some computer programs for the display of cartographic and stratigraphic data in geology. By D. G. Farmer and L. Johnson. Price £1.15.

No. 75/9 An automatic data-handling system for quantitative X-ray microprobe analysis. By J. F. W. Bowles. Price 35p.

No. 75/10 Chart of the magnetic declination for the British Isles, epoch 1975.0. By F. M. Avann and D. R. Barraclough. Price 40p.

No. 75/11 A deep seismic survey in the Moray Firth. By J. A. Chesher and M. Bacon. Price 45p.

Government publications can be bought from the Government Bookshops in London (post orders to P. O. Box 569, SE1), Edinburgh, Cardiff, Belfast, Manchester, Birmingham, Bristol or through booksellers. Postage is not included in the prices given.

The full range of Institute publications is displayed and sold at the Institute's Bookshop.

*Price not yet fixed

Her Majesty's Stationery Office

Government Bookshops

49 High Holborn, London WC1V 6HB
13a Castle Street, Edinburgh EH2 3AR
41 The Hayes, Cardiff CF1 1JW
Brazennose Street, Manchester M60 8AS
Southey House, Wine Street, Bristol BS1 2BQ
258 Broad Street, Birmingham B1 2HE
80 Chichester Street, Belfast BT1 4JY

Government publications are also available through booksellers

The full range of Institute publications is displayed and sold at the Institute's Bookshop at the Geological Museum, Exhibition Road, London SW7 2DE

ISBN 0 11 880740 4